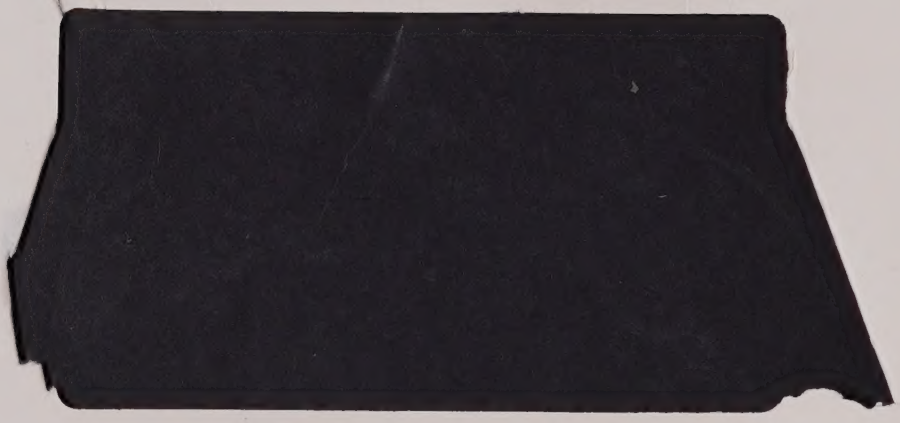
INSTRUCTION MANUAL

emc

MICROWAVE
NOISE AND FIELD
INTENSITY METER
MODEL EMA-910

SINGER
INSTRUMENTATION



INSTRUCTION MANUAL

emc

MICROWAVE
NOISE AND FIELD
INTENSITY METER
MODEL EMA-910

Serial No. _____

Instruction Manual No. 910-300

SINGER
INSTRUMENTATION

Precision electrical and electronic instruments for measurement

emc · EMPIRE* · Gertsch* · Panoramic* · Sensitive Research*

THE SINGER COMPANY • METRICS DIVISION

*A Trademark of THE SINGER COMPANY

WARRANTY

THE SINGER COMPANY, METRICS DIVISION, warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

Sensitive Research Electrical Indicating Instruments.....2 years
Other Electrical and Electronic Measuring Instruments.....1 year

Repair or replacement (at our option) without charge (F.O.B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuses, lamps, thermoelements, and *RatioTran* potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other obligations or liabilities expressed or implied and The Singer Company neither assumes, nor authorizes any person to assume for them, any other liability in connection with sales of instruments manufactured by The Singer Company, Metrics Division.

THE SINGER COMPANY • METRICS DIVISION
HOME OFFICE: 915 PEMBROKE STREET, BRIDGEPORT, CONNECTICUT

REPAIR AND MAINTENANCE

Instruments should be returned only on prior written authorization from the Singer Representative or the factory(1). Warranty repair will be made upon written request. Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(2)
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

(1) Contact Metrics Division, 915 Pembroke St., Bridgeport, Connecticut for *Empire*, *Panoramic*, and *Sensitive Research* instruments.
Contact Metrics Division, 3211 S. LaCienega Blvd., Los Angeles, California for *Gertsch* instruments.
Contact Metrics Division, 7338 Varna Ave., N. Hollywood, California for *EMC* instruments.

(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

NOTE

In keeping with standard commercial practice, all units of frequency are noted in hertz, kilohertz, etc. Front panel screening, however, still appears in cycles, kilocycles, etc.

We regret this slight inconvenience and are now in the process of rescreening our front panels.

Thank you.

TABLE OF CONTENTS

Paragraph		Page
	SECTION I—INTRODUCTION	
1-1	Scope of Manual	1-1
1-4	Purpose and Use of the Equipment	1-1
1-7	General Description	1-1
1-11	Accessories	1-2
1-13	Model 1000 Tripod	1-2
1-14	Model 1001 Antenna Reflector	1-2
1-15	Model 1002 Antenna Mounting Base	1-2
1-16	Model 1003 Tripod Case	1-2
1-17	Calibrated Antennas	1-2
1-18	Model 2002 X-Y Recorder Cable	1-3
1-19	Model 2003 Oscilloscope Cable	1-3
1-20	Model 2004 I-f Cable	1-3
1-21	Model 2005 Power Cable	1-7
1-22	Model 2006 Power Cable	1-7
1-23	Model 2007 I-f Cable	1-7
1-24	Model 3010 Earphones	1-7
1-25	Model 3020 Speaker	1-7
1-26	Model 3030 Remote Meter	1-8
1-27	Model 3040 Accessory Case	1-8
1-28	Model 3045 Data Evaluation Unit Transit Case	1-8
1-29	Model 3046 Frequency Selection Unit Transit Case	1-8
1-30	Model 3050 Instrument Case	1-8
1-31	Model 3100 Digital Display Unit	1-8
1-32	Model 8010 Ten Channel Call-up Unit	1-8
1-33	Model 5010 Junction Box	1-8
1-34	80632 Series Extender Boards	1-8
1-35	Specifications	1-8
1-37	Electron Tube, Transistor, Diode, Fuse and Indicator Lamp Complement	1-12
	SECTION II—OPERATION	
2-1	General	2-1
2-3	Installation	2-1
2-5	Unpacking	2-1
2-6	Inspection	2-1
2-7	Bench Mounting	2-1
2-8	Cart Mounting	2-1
2-9	Rack Mounting	2-1
2-12	Operation	2-1
2-14	Operating Controls, Indicators and Connectors	2-1
2-15	Preparation for Use	2-3
2-16	Manually Tuned Operation	2-13
2-17	Afc Operation	2-16
2-18	Slideback Peak Measurements	2-16
2-19	High Level Signal Indication	2-17
2-20	Semiautomatic Single Sector Scan Operation	2-17
2-21	Automatic Signal Surveillance	2-20
2-22	Packaging Instructions	2-20
2-23	Short Term Storage	2-20
2-24	Long Term Storage or Shipment	2-20

TABLE OF CONTENTS (Cont'd)

Paragraph		Page
	SECTION III—THEORY OF OPERATION	
3-1	General	3-1
3-3	Simplified Block Diagram Analysis	3-1
3-12	Detailed Circuit Analysis, R-f Section	3-2
3-13	Input Signal Routing	3-2
3-15	Calibration Signal Routing	3-2
3-16	Impulse Generator Z104	3-2
3-17	Impulse Generator Driver A104	3-7
3-18	Tuner Selection	3-7
3-19	Tuners A124, A125, A126 and A127	3-7
3-23	Balanced Mixers A111, A112, A113 and A114	3-7
3-24	240-MHz Preamplifiers A107, A108, A109 and A110	3-7
3-25	Preamplifier Selection	3-7
3-26	Detailed Circuit Analysis, Tuning Modes	3-7
3-27	Manual Tuning Mode	3-7
3-33	Semiautomatic Single Sector Scan Mode	3-10
3-41	Automatic Continuous Sector Scan Mode	3-13
3-46	Clock Oscillator A102	3-14
3-47	Voltage Comparators	3-14
3-49	Scan Direction Control Flip-flop A212	3-15
3-55	Detailed Circuit Analysis, Afc Loops	3-15
3-57	60-MHz I-f Amplifier/Afc Discriminator A222	3-15
3-60	Afc Bipolar Pulse Stretcher A211	3-16
3-62	Afc Bipolar Chopper A106	3-16
3-63	Afc Pulse Amplifier A101	3-16
3-66	Afc Operational Amplifier A115	3-19
3-67	Servo Bipolar Chopper/Preamplifier A103	3-19
3-70	Detailed Circuit Analysis, I-f, Video and Metering Sections	3-21
3-71	240-MHz Signal Sampler	3-21
3-72	240-MHz Bandpass Filter FL201	3-21
3-73	240-MHz I-f Attenuator	3-21
3-75	240/60-MHz Mixer A225	3-22
3-76	Crystal-Controlled Oscillator A226	3-22
3-77	60-MHz I-f Attenuator	3-22
3-79	60-MHz Linear I-f Amplifier A220	3-22
3-81	I-f Bandwidth Limiting	3-27
3-83	60-MHz Signal Sampler	3-27
3-84	60-MHz Logarithmic I-f Amplifier A221	3-27
3-87	Video Buffer/Peak Driver Amplifier A223	3-27
3-90	Peak Operational Amplifier A217	3-29
3-91	Peak Hold Circuitry	3-29
3-97	Memory Clear Pulse Amplifier A209	3-31
3-99	Slideback/Video Stretch Amplifier A210	3-31
3-101	Metering Operational Amplifier A218	3-32
3-102	Audio Amplifier A201	3-32
3-103	Power Distribution	3-32
3-105	Line Voltage Switching	3-32
3-106	+12/+24 Volt Supplies	3-32
3-107	-12/-24 Volt Supplies	3-32
3-108	+27 Volt Supply	3-32
3-109	Floating ±28.5 Volt Supplies	3-32
3-110	High Voltage Power Supply	3-32
3-111	115-Volt 400-Hz Supply	3-32
	SECTION IV—MAINTENANCE	
4-1	General	4-1
4-3	Required Test Equipment	4-1
4-5	Minimum Performance Standards Checks	4-1

TABLE OF CONTENTS (Cont'd)

Paragraph		Page
	SECTION IV—MAINTENANCE (Cont'd)	
4-7	Component Locations	4-21
4-9	Power Supply Trouble Localization	4-25
4-11	Localizing Equipment Trouble	4-25
4-13	R-f Circuitry Troubleshooting and Alignment Procedures	4-25
4-15	Local Oscillator Alignment	4-25
4-18	240-MHz Preamplifiers, Alignment Procedure	4-48
4-19	Preselector Alignment	4-49
4-22	Impulse Calibrator, Troubleshooting Procedure	4-52
4-23	R-f Component Removal and Replacement Procedures	4-53
4-25	Tuner Removal	4-53
4-26	Replacement of Reflex Klystron Tube	4-54
4-29	Local Oscillator Probe Replacement	4-54
4-30	Removal of Servo Drive A121	4-54
4-31	I-f Circuitry Troubleshooting and Alignment Procedures	4-54
4-33	60-MHz Logarithmic I-f Amplifier A221, Alignment	4-54
4-34	60-MHz Linear I-f Amplifier A220, Alignment	4-56
4-35	240/60-MHz Mixer A225, Alignment	4-56
4-36	Crystal-Controlled Oscillator A226, Alignment	4-57
4-37	Output Meter Calibration Procedure	4-57
4-39	Afc Circuitry Alignment Procedures	4-60
4-41	60-MHz I-f Amplifier/Afc Discriminator A222, Alignment	4-60
4-42	Afc Pulse Amplifier A101, Alignment	4-61
4-43	Balancing Afc Operational Amplifier A115	4-61
4-44	Scanning Circuitry Replacement and Alignment Procedures	4-62
4-46	Replacement of Tuner Dual Tracking Potentiometer	4-62
4-47	Replacement of Tuner Limit Microswitches	4-63
4-48	X Analog Output Voltage Calibration	4-63
4-49	Scan Limit Frequency Calibration	4-64
4-50	Revising Gain Calibration and Data Normalization Curves	4-64
4-52	Gain Calibration Curve	4-64
4-53	Data Normalization Curve	4-65
4-54	Voltage Measurements	4-66
	SECTION V—SCHEMATIC DIAGRAMS	
	SECTION VI—PARTS LIST	
6-1	Introduction	6-1
6-3	Ordering Information	6-1
6-5	How to Use the Parts List	6-1
6-7	Ref Symbol Column	6-1
6-8	Description Column	6-1
6-9	Manufacturer's Part Number Column	6-1
6-10	Mfr's Code Column	6-1
6-11	Maint Qty Column	6-1

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Model EMA-910 Noise and Field Intensity Meter System	viii
1-2	Supplied Accessories	1-3
1-3	Model 3100 Digital Display Unit.	1-4
1-4	Model 8010 Ten Channel Call-up Unit	1-4
1-5	Optional Accessories	1-6
2-1	Outline Dimension Drawing	2-2
2-2	Operating Controls, Indicators and Connectors	2-4
2-3	Interconnecting Cabling Diagram	2-12
2-4	Gain Calibration Curve	2-14
2-5	Attenuation Versus Frequency Characteristics, 6-Foot R-f Cable 910-160	2-15
2-6	Antenna Factor Versus Frequency Characteristics - Models 1010, 1020, 1030 and 1040 Horn Antennas	2-17
2-7	Recorder Interconnection Diagram	2-18
2-8	Sample Precalibrated Graph Paper for Use in Conjunction with a Standard 8-1/2 x 11 Inch X-Y Recorder	2-19
2-9	Normalization Curve	2-21
2-10	Packaging Diagram	2-22
3-1	Model EMA-910 Noise and Field Intensity Meter, Simplified Block Diagram	3-3
3-2	R-f Signal Routing Diagram	3-5
3-3	Typical Characteristics of Reflex Klystron Local Oscillator A125V1	3-9
3-4	Scan Control Circuitry, Composite Schematic Diagram	3-11
3-5	Afc Circuitry, Detailed Block Diagram.	3-17
3-6	Multivibrator Output Waveforms	3-19
3-7	Typical Frequency and Voltage Changes Produced by Electronic Afc Loop (Band 2 or Band 4 Tuner Operative)	3-20
3-8	Typical Klystron Electronic Tuning Characteristics	3-21
3-9	I-f, Video and Metering Circuitry, Detailed Block Diagram	3-23
3-10	60-MHz Logarithmic I-f Amplifier Transfer Characteristics	3-28
3-11	Typical Peak Hold Circuitry Waveforms	3-30
4-1	Minimum Performance Standards Checks Test Setup No. 1	4-18
4-2	Minimum Performance Standards Checks Test Setup No. 2	4-18
4-3	Minimum Performance Standards Checks Test Setup No. 3	4-19
4-4	Minimum Performance Standards Checks Test Setup No. 4	4-19
4-5	Minimum Performance Standards Checks Test Setup No. 5	4-20
4-6	Minimum Performance Standards Checks Test Setup No. 6	4-20
4-7	Data Evaluation Unit, Top View	4-21
4-8	Data Evaluation Unit, Bottom View	4-22
4-9	Frequency Selection Unit, Top View	4-23
4-10	Frequency Selection Unit, Bottom View	4-24
4-11	+12/+24 Volt Regulator A202	4-33
4-12	Transistor and Diode Bracket A230	4-33
4-13	-12/-24 Volt Regulator A203	4-33
4-14	+27 Volt Regulator A204	4-33
4-15	Floating ±28.5 Volt Regulator A207	4-34
4-16	400-Hz and High Voltage Power Supply A228	4-34
4-17	400-Hz Oscillator A228A1	4-34
4-18	Band 1 and Band 2 Local Oscillator Alignment, Equipment Setup	4-42
4-19	Typical Low Band Tuner	4-42
4-20	Local Oscillator Tracking and Preamplifier Tuning Controls	4-44
4-21	Band 3 and Band 4 Local Oscillator Alignment, Equipment Setup	4-45
4-22	Typical High Band Tuner	4-46
4-23	Balanced Mixer/240-MHz Preamplifiers (Bands 1 and 2)	4-48
4-24	High-Impedance Probe, Schematic Diagram	4-49
4-25	Preselector Alignment Setup	4-51
4-26	Orientation of Preselector Eccentric Adjustments	4-52
4-27	Oscilloscope Waveforms During Preselector Alignment	4-52
4-28	Impulse Calibrator Driver A104	4-53
4-29	60-MHz Logarithmic I-f Amplifier A221	4-55
4-30	Alignment of 60-MHz Logarithmic I-f Amplifier A221, Equipment Setup	4-56
4-31	60-MHz Linear I-f Amplifier A220	4-57
4-32	240/60-MHz Mixer A225	4-58
4-33	Crystal-Controlled Oscillator A226	4-58

LIST OF ILLUSTRATIONS (Cont'd)

Figure		Page
4-34	Metering Circuitry Controls	4-59
4-35	Alignment of 60-MHz I-f Amplifier/Afc Discriminator A222, Equipment Setup	4-60
4-36	60-MHz I-f Amplifier/Afc Discriminator A222	4-61
4-37	Discriminator Output Characteristics	4-62
4-38	Afc Pulse Amplifier A101	4-62
4-39	X Analog Voltage Tracking Adjustments A105	4-64
5-1	Model EMA-910-10 Frequency Selection Unit, Schematic and Interassembly Wiring Diagram	5-3
5-2	Afc Pulse Amplifier A101, Schematic Diagram	5-7
5-3	Clock Oscillator A102, Schematic Diagram	5-9
5-4	Servo Bipolar Chopper/Preamplifier A103, Schematic Diagram	5-11
5-5	Impulse Generator Driver A104, Schematic Diagram	5-13
5-6	Analog X Voltage Tracking Adjustments A105, Schematic Diagram	5-15
5-7	Afc Bipolar Chopper A106, Schematic Diagram	5-17
5-8	240-MHz Preamplifiers A107, A108, A109, and A110 and Balanced Mixers A111, A112, A113 and A114, Schematic Diagram	5-19
5-9	Model EMA-910-11 Data Evaluation Unit, Schematic and Interassembly Wiring Diagram	5-21
5-10	Audio Amplifier A201, Schematic Diagram	5-25
5-11	Schmitt Trigger A205, Schematic Diagram	5-27
5-12	Multivibrator/Integrator A206, Schematic Diagram	5-29
5-13	Voltage Comparators A208, A213, A214, A215 and A216, Schematic Diagram	5-31
5-14	Memory Clear Pulse Amplifier A209, Schematic Diagram	5-33
5-15	Slideback/Video Stretch Amplifier A210, Schematic Diagram	5-35
5-16	Afc Bipolar Pulse Stretcher A211, Schematic Diagram	5-37
5-17	Scan Direction Control Flip-flop A212, Schematic Diagram	5-39
5-18	Peak Operational Amplifier A217, Schematic Diagram	5-41
5-19	60-MHz Linear I-f Amplifier A220, Schematic Diagram	5-43
5-20	60-MHz Logarithmic I-f Amplifier A221, Schematic Diagram	5-45
5-21	60-MHz I-f Amplifier/Afc Discriminator A222, Schematic Diagram	5-47
5-22	Video Buffer/Peak Driver Amplifier A223, Schematic Diagram	5-49
5-23	Signal Samplers/I-f Attenuators A224, Schematic Diagram	5-51
5-24	240/60-MHz Mixer A225, Schematic Diagram	5-53
5-25	Crystal-Controlled Oscillator A226, Schematic Diagram	5-55
5-26	Data Evaluation Unit Power Supplies, Composite Schematic and Interassembly Wiring Diagram	5-57
6-1	Parts List Sample	6-2

LIST OF TABLES

Table		Page
1-1	Supplied Accessories	1-2
1-2	Optional Auxiliary Equipment and Accessories	1-5
1-3	Minimum Narrowband (Cw) Sensitivity - RMS Analysis Mode	1-10
1-4	Minimum Broadband (Impulsive) Sensitivity - PEAK Analysis Mode	1-10
1-5	Remove Data Connector Pin Information	1-11
1-6	Frequency Selection Unit Electron Tube, Transistor and Diode Complement	1-13
1-7	Data Evaluation Unit Transistor and Diode Complement	1-16
1-8	Fuse and Indicator Lamp Complement	1-24
2-1	Data Evaluation Unit Operating Controls, Indicators and Connectors	2-3
2-2	Frequency Selection Unit Operating Controls, Indicators and Connectors	2-11
2-3	Initial Control Settings	2-13
2-4	Selection of Analysis Mode as a Function of Applied Signal Characteristics	2-16
3-1	Tuner Comparison Chart	3-8
3-2	Voltage Comparator Functions	3-14
3-3	Electronic Afc Sequence of Events	3-19
3-4	Inputs to Memory Clear Pulse Amplifier A209	3-31
4-1	Required Test Equipment	4-1
4-2	Initial Control Settings for Minimum Performance Standards Checks	4-1
4-3	Minimum Performance Standards Checks	4-2
4-4	Power Supply Trouble Localization Procedure	4-26
4-5	Symptomatic Troubleshooting Guide	4-35
4-6	R-f Circuitry Troubleshooting Procedure	4-37
4-7	I-f Circuitry Troubleshooting Procedure	4-38
4-8	Preamplifier Alignment Data	4-49
4-9	Voltage Measurements, Afc Pulse Amplifier A101	4-66
4-10	Voltage Measurements, 240-MHz Preamplifiers A107, A108, A109 and A110	4-66
4-11	Voltage Measurements, Audio Amplifier A201	4-66
4-12	Voltage Measurements, +12/+24 Volt Regulator A202	4-67
4-13	Voltage Measurements, -12/-24 Volt Regulator A203	4-67
4-14	Voltage Measurements, +27 Volt Regulator A204	4-67
4-15	Voltage Measurements, Floating ±28.5 Volt Regulator A207	4-68
4-16	Voltage Measurements, Voltage Comparators A208, A213, A214, A215 and A216	4-68
4-17	Voltage Measurements, Memory Clear Pulse Amplifier A209	4-68
4-18	Voltage Measurements, Slideback/Video Stretch Amplifier A210	4-69
4-19	Voltage Measurements, Afc Bipolar Pulse Stretcher A211	4-69
4-20	Voltage Measurements, Scan Direction Control Flip-Flop A212	4-69
4-21	Voltage Measurements, Peak Operational Amplifier A217	4-70
4-22	Voltage Measurements, 60-MHz Linear I-f Amplifier A220	4-70
4-23	Voltage Measurements, 60-MHz Logarithmic I-f Amplifier A221	4-71
4-24	Voltage Measurements, 60-MHz I-f Amplifier/AFC Discriminator A222	4-71
4-25	Voltage Measurements, Video Buffer/Peak Driver Amplifier A223	4-72
4-26	Voltage Measurements, 240/60-MHz Mixer A225	4-72
4-27	Voltage Measurements, Crystal-Controlled Oscillator A226	4-72
4-28	Voltage Measurements, 400-Hz and High Voltage Supply A228	4-72
4-29	Voltage Measurements, Heat Sink A229	4-73
4-30	Voltage Measurements, Transistors and Diode Bracket A230	4-73
4-31	Voltage Measurements, +27 Volt Supply Overload Protector A234	4-73
6-1	Manufacturer's Code	6-2
6-2	Parts List, Model EMA-910-10 Frequency Selection Unit	6-5
6-3	Parts List, Model EMA-910-11 Data Evaluation Unit	6-19

WARNING

HIGH VOLTAGE

is used in the operation of this equipment

DEATH ON CONTACT

may result if personnel fail to observe safety precautions

Learn the areas containing high voltage

in each piece of equipment

Be careful not to contact high-voltage connections

when installing or operating this equipment

Before working inside the equipment, turn power

off and ground points of high potential

before touching them

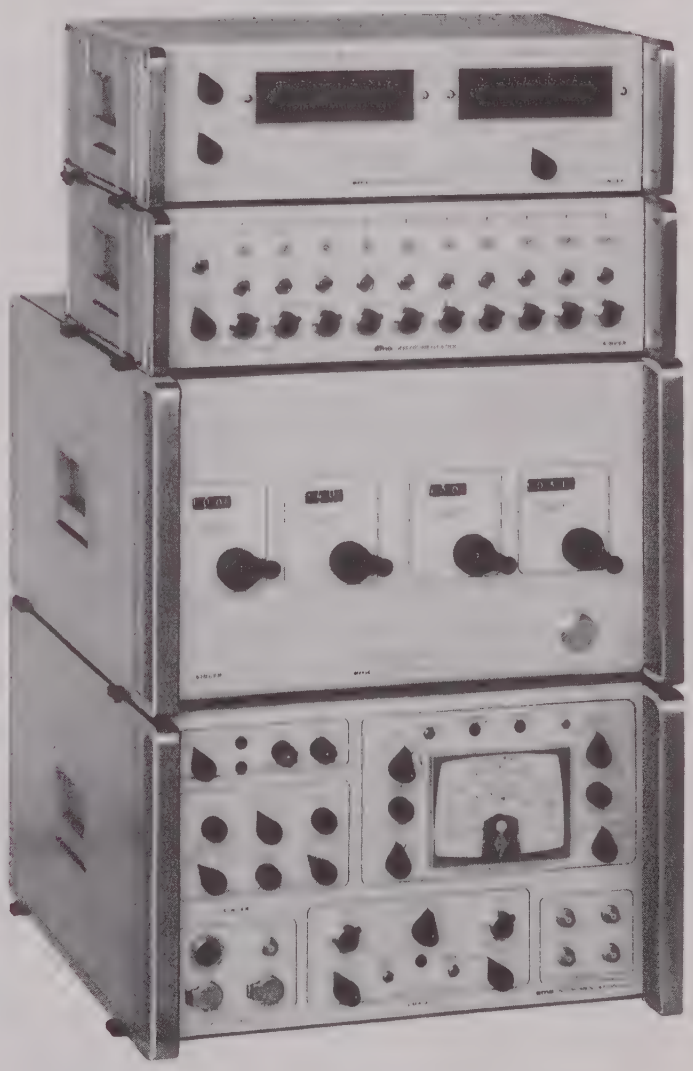


Figure 1-1. Model EMA-910 Noise and Field Intensity Meter System (Shown with Optionally Available Digital Display Unit and Ten Channel Call-Up Unit)

SECTION I
INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This instruction manual provides operating and service information for the 1.0- to 10.5-GHz capability of the Model EMA-910 1.0- to 26.5-GHz Noise and Field Intensity Meter System (see figure 1-1) manufactured by EMC Instrumentation, Inc., a subsidiary of The Singer Company - Metrics Division. Included in this manual are a general description of the equipment and optionally available accessories, operating instructions and procedures, theory of operation, detailed maintenance instructions and data, schematic diagrams and a repair parts list.

Note

The description, operating instructions, theory of operation and maintenance information for the 10- to 26.5-GHz capability of the equipment is contained in a supplement to this handbook.

1-3. The information contained in this handbook reflects the Model EMA-910 1-10.5 GHz Noise and Field Intensity Meter (hereafter referred to as the EMA-910) and is current only to the date of publication. Differences in equipment configuration, components, specifications and performance resulting from customer application requirements and/or The Singer Company's continuous product improvement program are described in addendum sheets.

1-4. PURPOSE AND USE OF THE EQUIPMENT.

1-5. The EMA-910 is a sophisticated and extremely sensitive calibrated Noise and Field Intensity Meter which, in conjunction with accessory calibrated antennas, enables the user to evaluate the characteristics (absolute magnitude, frequency, spectral distribution, modulation, etc.) of r-f fields and interference within the 1.0- to 10.5-GHz band of the electromagnetic spectrum in accordance with standard military and commercial RFI specifications. Some typical applications of the EMA-910 are listed below:

a. Determining the presence, level and characteristics of conducted and radiated r-f signals within the frequency range from 1.0 to 10.5 GHz;

b. Field intensity measurements;

c. Electromagnetic interference measurements in accordance with all standard military and commercial specifications;

d. Antenna pattern analysis;

e. Sensitive tunable two-terminal voltmeter;

f. Determining harmonic and/or spurious transmitter outputs;

g. Measuring receiver local oscillator radiation;

h. Evaluating the area of useful transmitter coverage;

i. Frequency surveillance receiver.

1-6. Inquiries are invited regarding special applications of the EMA-910 to particular customer requirements. Such inquiries should be directed to the attention of the Applications Engineering Department.

1-7. GENERAL DESCRIPTION.

1-8. The EMA-910 is a compact, self-contained instrument consisting of two interconnected cabinet assemblies; a Model EMA-910-10 Frequency Selection Unit and a Model EMA-910-11 Data Evaluation Unit. The EMA-910 is essentially an extremely sensitive frequency-selective broadband calibrated two-terminal voltmeter covering the frequency range from 1.0 to 10.5 GHz. In addition to conventional microwave receiver features and capabilities, the EMA-910 incorporates:

a. Four self-contained tuners which permit rapid measurement of signals present at any frequency between 1.0 and 10.5 GHz. (Band switching requires only changing of a single switch setting rather than the time-consuming method of shutting down, physically interchanging tuners and the subsequent equipment re-energization and warmup.)

b. A self-contained broadband impulse generator for calibrating the equipment at the frequency of operation.

c. Triple-cavity preselectors for each tuner and a high-frequency first i-f to provide adequate image and spurious response rejection.

d. The capability of physically placing the r-f section of the equipment in close proximity to inaccessibly-located antennas (i.e., shipboard masts and tower tops) to minimize r-f cable losses.

e. Both electronic and electromechanical afc (automatic frequency control) to lock onto applied signals despite frequency drift.

f. Both high-frequency (pre i-f, post i-f, video and fm) and low-frequency (audio and stretched video) outputs for application to auxiliary test equipment.

g. Automatic scanning circuitry for either single or continuous sector scanning of any segment (up to the full range) of the 1.0- to 10.5-GHz band. Band switching is automatic.

h. Analog x (frequency) and y (amplitude) outputs for permanent recording of measurement data.

i. Selectable i-f bandwidths to permit evaluation of signal spectral distribution.

j. A rear panel multipin connector for coupling of remote readout and/or control equipment.

1-9. The Model EMA-910-10 Frequency Selection Unit (hereafter referred to as the Frequency Selection Unit) contains four microwave tuner assemblies (each consisting of a triple-cavity preselector and tunable reflex klystron local oscillator) and their associated balanced mixers/preamplifiers, both manual and automatic motor drive systems for tuning, r-f attenuators, a broadband impulse generator and the electrical switching circuitry for routing the applied signal.

1-10. The Model EMA-910-11 Data Evaluation Unit (hereafter referred to as the Data Evaluation Unit) contains the circuits and components common to all tuners (such as i-f amplifiers, i-f attenuators, bandwidth-limiting filters, detectors, metering amplifiers, etc.) as well as both the high and low voltage power supplies.

1-11. ACCESSORIES.

1-12. The accessories furnished as part of the EMA-910 system are listed in table 1-1 and illustrated in figure 1-2. Optionally available auxiliary equipment (see figures 1-3 and 1-4) and accessories (see figure 1-5), supplied only when specifically ordered, are listed in table 1-2 and described in paragraphs 1-13 through 1-33.

1-13. MODEL 1000 TRIPOD. Provides a stable base for mounting antennas and/or antenna mounting base. The tripod legs can be extended from 39 inches (fully collapsed) to a maximum of 67 inches.

1-14. MODEL 1001 ANTENNA REFLECTOR. An 18-inch diameter parabolic dish reflector employed to focus incident radiated fields at the mouth of either the Model 1030 or 1040 Horn Antenna, thereby increasing their effective areas.

1-15. MODEL 1002 ANTENNA MOUNTING BASE. Antenna and/or antenna reflector mounting platform for installation atop the Model 1000 Tripod. Individual locking screws permit rotation of antenna a full 360° in azimuth and up to 150° in elevation.

1-16. MODEL 1003 TRIPOD CASE. Transit and storage case for Model 1000 Tripod.

1-17. CALIBRATED ANTENNAS. Four calibrated directional horn antennas and one calibrated broadband spiral cone antenna are available, each having a nominal output impedance of 50 ohms.

a. Model 1010 Horn Antenna for use in conjunction with the band 1 (1.0 to 2.5 GHz) tuner.

b. Model 1020 Horn Antenna for use in conjunction with the band 2 (2.4 to 4.4 GHz) tuner.

TABLE 1-1. SUPPLIED ACCESSORIES

EMC Model or Part Number	Figure 1-2 Index Number	Nomenclature
910-015	1	1.5-Foot Power Cable
910-060	2	6-Foot Line Cable (with Adapter)
910-115	3	1.5-Foot I-f Cable
910-160	4	6-Foot R-f Cable
2008	5	Alignment Harness
6010	6	EMI Calculator
910-300	Not Shown	Instruction Manual

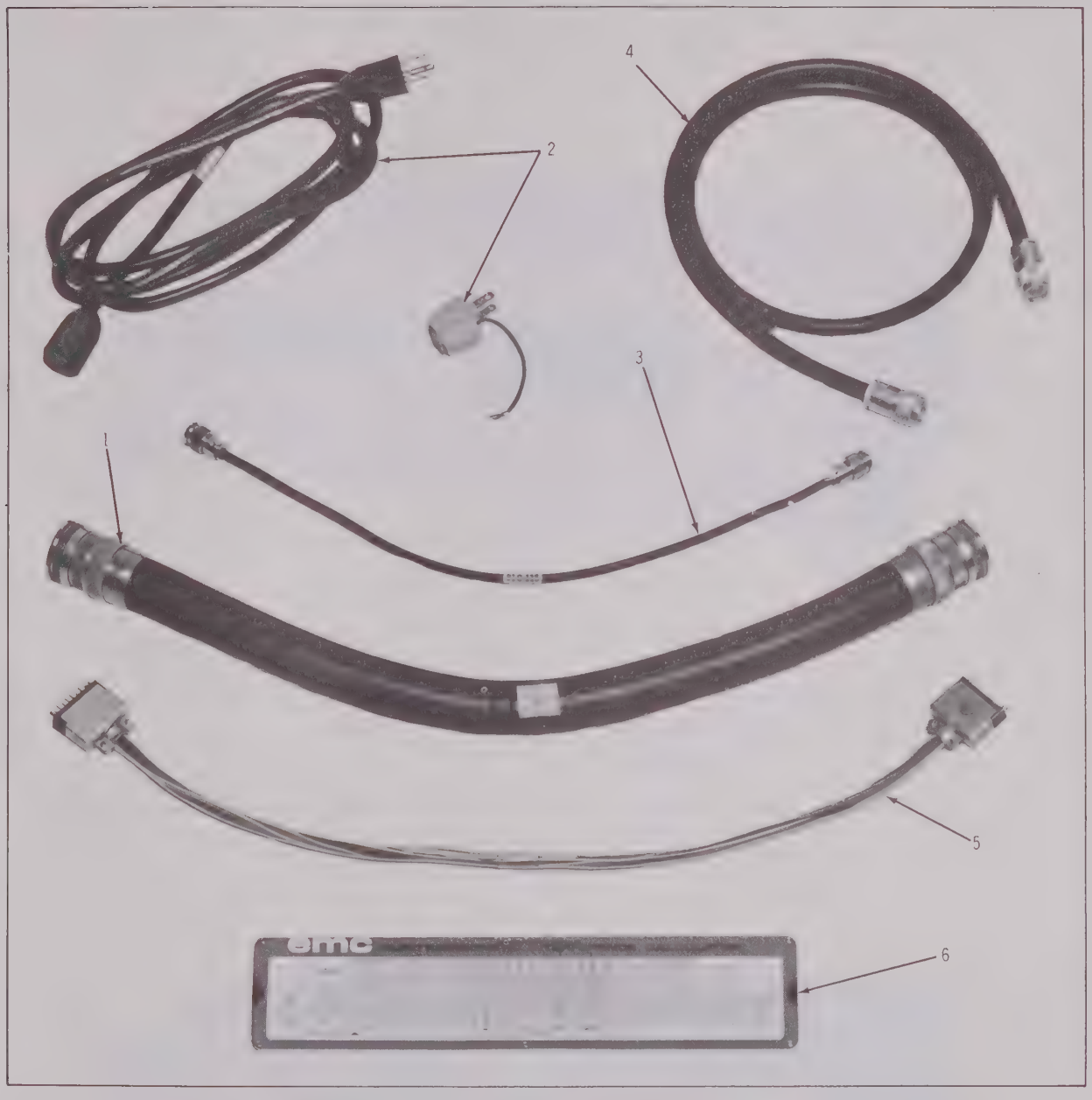


Figure 1-2. Supplied Accessories (Table 1-1)

c. Model 1030 Horn Antenna for use in conjunction with the band 3 (4.3 to 7.3 GHz) tuner. This antenna must be mounted on the Model 1001 Antenna Reflector.

d. Model 1040 Horn Antenna for use in conjunction with the band 4 (7.2 to 10.5 GHz) tuner. This antenna must be mounted on the Model 1001 Antenna Reflector.

e. Model 1200 Spiral Cone Antenna for use in conjunction with all (1.0 to 10.5 GHz) tuners. This antenna is supplied with its own calibration curve and carrying case.

1-18. MODEL 2002 X-Y RECORDER CABLE. Six-foot multiconductor cable assembly employed to couple an auxiliary x-y recorder to the EMA-910 front panel X-Y connector.

1-19. MODEL 2003 OSCILLOSCOPE CABLE. Four-foot coaxial cable assembly (type RG-58A/U coaxial cable terminated with type BNC connectors at each end) employed to couple an auxiliary oscilloscope to the EMA-910 front panel VIDEO, STRETCHED VIDEO or FM connector.

1-20. MODEL 2004 I-F CABLE. Six-foot coaxial cable assembly (type RG-58A/U coaxial cable terminated with type BNC connectors at each end) employed to couple an auxiliary spectrum signature panadaptor to the EMA-910 front panel 240 MHZ or 60 MHZ connector.

Figure 1-3. Model 3100 Digital Display Unit

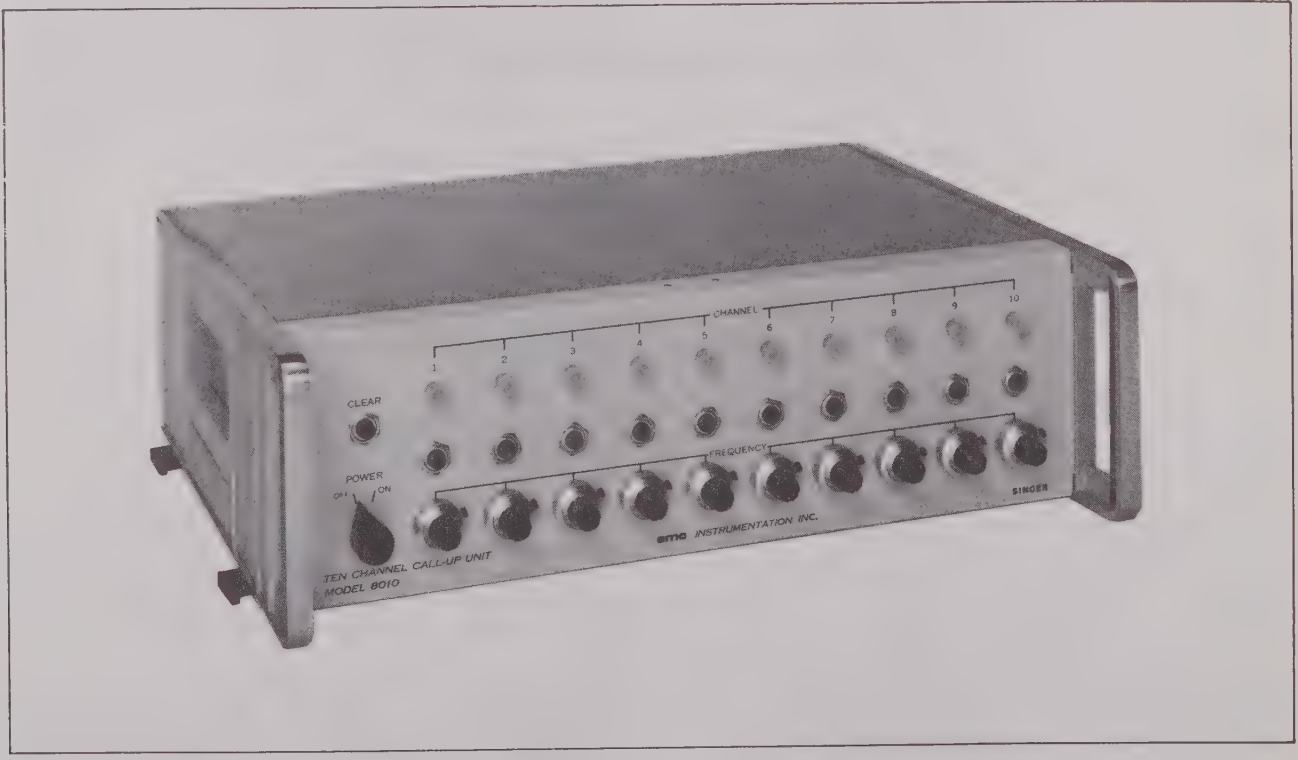


Figure 1-4. Model 8010 Ten Channel Call-up Unit

TABLE 1-2. OPTIONAL AUXILIARY EQUIPMENT AND ACCESSORIES

EMC Model Number	Index Number* or Figure	Nomenclature
3100	Fig. 1-3	Digital Display Unit
8010	Fig. 1-4	Ten Channel Call-up Unit
1000	14	Tripod
1001	16	Antenna Reflector
1002	15	Antenna Mounting Base
1003	22	Tripod Case
1010	6	Horn Antenna
1020	4	Horn Antenna
1030	17	Horn Antenna
1040	7	Horn Antenna
1200	2	Spiral Cone Antenna (with Carrying Case)
2002	1	X-Y Recorder Cable
2003	13	Oscilloscope Cable
2004	11	I-f Cable
2005	10	Power Cable
2006	12	Power Cable
2007	9	I-f Cable
3010	3	Earphones
3020	8	Speaker (with Cable)
3030	5	Remote Meter (with Cable)
3040	18	Accessory Case
3045	19	Data Evaluation Unit Transit Case
3046	21	Frequency Selection Unit Transit Case
3050	20	Instrument Cart
5010	Not Shown	Junction Box
80632 Series	Not Shown	Extender Boards

*Figure 1-5.

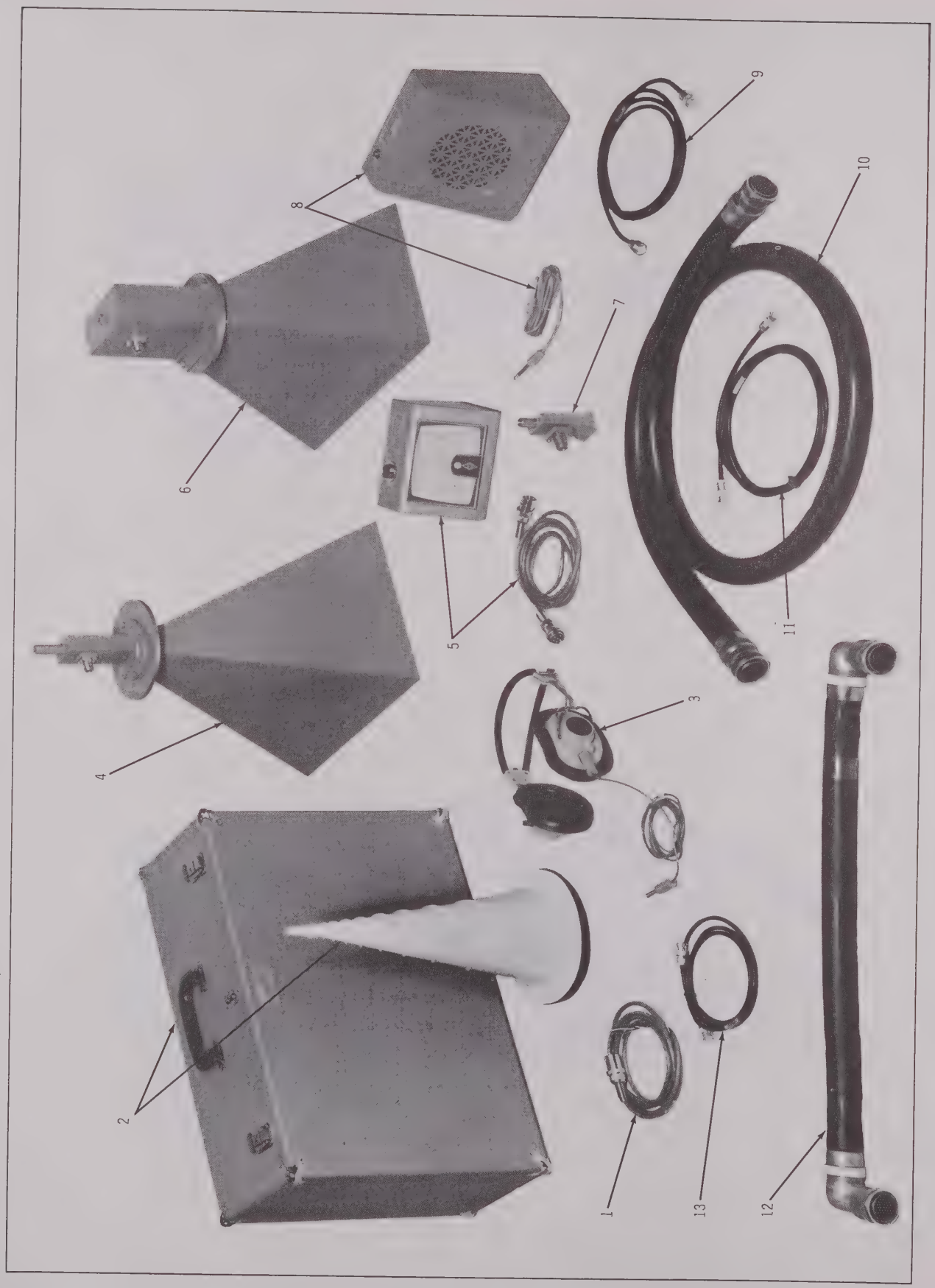


Figure 1-5. Optional Accessories, Sheet 1 of 2 (Table 1-2)

Figure 1-5. Optional Accessories, Sheet 2 of 2 (Table 1-2)

1-21. MODEL 2005 POWER CABLE. Six-foot shielded multiconductor cable assembly (terminated with 55-pin connectors at each end) employed to couple operating power, command, control and other signals between the Frequency Selection Unit and the Data Evaluation Unit when the two are mounted in other than their normal piggyback configuration.

1-22. MODEL 2006 POWER CABLE. Eighteen-inch shielded multiconductor cable assembly (terminated with 55-pin right-angle connectors at each end) employed to couple operating power, command, control and other signals between the Frequency Selection Unit and the Data Evaluation Unit when the two are installed in a 19-inch rack.

1-23. MODEL 2007 I-F CABLE. Six-foot coaxial cable assembly (type RG-223/U coaxial cable terminated with type TNC connectors at each end) employed to couple the 240-MHz first i-f signal between the Frequency Selection Unit and the Data Evaluation Unit when the two are mounted in other than the normal piggyback configuration.

1-24. MODEL 3010 EARPHONES. A 600-ohm headset employed to monitor the audio-modulation content of intercepted signals (available at the EMA-910 front panel PHONES jack).

1-25. MODEL 3020 SPEAKER. An 8-ohm speaker employed to monitor the audio-modulation content

of intercepted signals (available at the EMA-910 SPEAKER jack) without being limited to the operator being physically within six feet of the equipment. A six-foot cable assembly is furnished to couple the speaker to the EMA-910 SPEAKER jack.

1-26. MODEL 3030 REMOTE METER. A duplicate output meter for monitoring intercepted signal levels at a distance up to six feet from the EMA-910. A six-foot cable assembly is furnished to couple the remote meter to the EMA-910 X-Y connector.

1-27. MODEL 3040 ACCESSORY CASE. Transit and storage case for the following items:

a. Model 1030 Horn Antenna
b. Model 1040 Horn Antenna
c. Model 2002 X-Y Recorder Cable
d. Model 2003 Oscilloscope Cable
e. Model 2004 I-f Cable
f. Model 2007 I-f Cable
g. Model 3010 Earphones
h. Model 3030 Remote Meter (with Cable)
i. 910-060 Line Cable (and Adapter)
j. 910-015 Power Patch Cable
k. 910-115 I-f Patch Cable
l. 910-160 R-f Cable

1-28. MODEL 3045 DATA EVALUATION UNIT TRANSIT CASE. Transit and storage container for the Data Evaluation Unit.

1-29. MODEL 3046 FREQUENCY SELECTION UNIT TRANSIT CASE. Transit and storage container for the Frequency Selection Unit.

1-30. MODEL 3050 INSTRUMENT CART. Cart for mounting both the Data Evaluation Unit and Frequency Selection Unit to permit equipment mobility.

1-31. MODEL 3100 DIGITAL DISPLAY UNIT. Auxiliary unit which permits monitoring of both the amplitude and frequency of the intercepted signal at remote locations.

1-32. MODEL 8010 TEN CHANNEL CALL-UP UNIT. Auxiliary unit which permits tuning the EMA-910 to any one of up to 10 continuously adjustable frequencies from a remote location.

1-33. MODEL 5010 JUNCTION BOX. Auxiliary unit which permits simultaneous operation of both the Model 3100 Digital Display Unit and Model 8010 Ten Channel Call-up Unit.

1-34. 80632 SERIES EXTENDER BOARDS. A set of seventeen plug-in extender boards for use in the maintenance and repair of the equipment printed-circuit boards.

1-35. SPECIFICATIONS.

1-36. The electrical and physical specifications for the EMA-910 are listed below.

Equipment classification	Double-conversion superheterodyne microwave receiver with self-contained impulse generator calibrator
Frequency range	Continuously tunable from 1.0 to 10.5 GHz by means of four overlapping-band tuners
Band 1 tuner	1.0 to 2.5 GHz
Band 2 tuner	2.4 to 4.4 GHz
Band 3 tuner	4.3 to 7.3 GHz
Band 4 tuner	7.2 to 10.5 GHz
Frequency accuracy	±0.5%
Input impedance	50 ohms (nominal)
Input connector	Type N, female
Input VSWR	Typically less than 2:1
Intermediate frequencies	Two
First i-f	240 MHz
Second i-f	60 MHz
Image rejection:	
1.0 to 8.5 GHz	70 dB or greater
Above 8.5 GHz	65 dB or greater
Spurious response rejection	85 dB or greater
Final i-f bandwidth (6 dB)	Four, selectable
0.5 MHz	0.5 ± 0.1 MHz, calibrated
1 MHz	1.0 ± 0.2 MHz, calibrated
5 MHz	5.0 ± 0.5 MHz, calibrated
Full	Approximately 10 MHz, uncalibrated
Detector functions	Direct-reading peak and rms for narrowband (cw and modulated cw) signals; direct-reading and metered slideback-peak for broadband (impulsive) signals

Peak hold	Continuously adjustable from approximately 500 microseconds to 5 seconds in four ranges
Uncalibrated	Same as above
Calibrated	0.01, 0.1, 0.5 and 5 seconds (nominal)
Maximum cw input signal level	10 volts rms
Signal attenuation	0 to 80 dB in 20-dB steps
R-f	40 dB in one step
I-f	40 dB in 20-dB steps
Indicating meter	6-3/4-inch taut band movement with scales calibrated linearly in dB (0 to 40) and logarithmically in microvolts (1 to 100)
Measurement range	120 dB (40-dB meter range plus 80-dB signal attenuation) less internal noise level
Signal measurement (two-terminal voltmeter) accuracy	±2 dB
Sensitivity	See tables 1-3 and 1-4
Calibrator	Self-contained, broadband impulse generator having a pulse repetition rate of 65 pps. Calibration referenced to the rms value of a sinusoidal signal
Automatic frequency control (afc)	Locks on intercepted signal frequency by electronic and/or electromechanical tuning
Mechanical tuning range	Tuner frequency limits
Automatic scan capability	Single or continuous sector scan, selectable
Scan width	Virtually 0 to 9.5 GHz (from 1.0 to 10.5 GHz)
Scan sweep rate	Continuously adjustable from 0 to approximately 75 MHz/second in two ranges
Slow	0 to approximately 7.5 MHz/second
Fast	0 to approximately 75 MHz/second
Band switching	Automatic
Sampled 240 MHz (pre i-f) output	Provided at front panel connector
Bandwidth	20 MHz
Output impedance	50 ohms
Level	Approximately 100 microvolts*
Sampled 60 MHz (post i-f) output	Provided at front panel connector
Bandwidth	Determined by selected i-f bandwidth
Output impedance	50 ohms
Level	Approximately 10 millivolts*
Fm output	Provided at front panel connector
Slope	1 volt/MHz
Bandwidth	10 MHz
Output impedance	50 ohms, d-c coupled
Video output	Provided at front panel connector
Bandwidth	5 MHz
Level	0 to +5 volts
Output impedance	50 ohms, d-c coupled
Stretched video output	Provided at front panel connector
Video stretch	30, 160 and 800 microseconds (nominal), selectable
Output impedance	50 ohms
Audio output:	
Speaker	0.5 watts into 8 ohms
Phones	150 milliwatts into 600 ohms
Analog X-Y (recorder or remote meter) output	Provided at front panel connector

* Equipment calibrated, full-scale output meter indication in RMS position of ANALYSIS MODE switch

Level . . . . . X: +1 to +10.5 volts as a function of frequency

Y: 0 to +4 volts as a function of meter pointer deflection

Output impedance . . . . . 500 ohms, d-c coupled

Remote data . . . . . 50-pin rear panel connector provided for coupling voltages indicative of signal levels, closures to ground corresponding to equipment operating mode as well as power, control and command voltages (see table 1-5) to auxiliary equipment

Construction . . . . . R-f shielded and gasketed in accordance with military specifications

Shielding effectiveness . . . . . Greater than 120 dB

Operating power requirements:

Line voltage . . . . . 115 or 230 volts, rms (±10%), single-phase

Frequency . . . . . 50 to 400 Hz

Power consumption . . . . 300 watts

Operational environment:

Temperature . . . . . -15°F to +125°F (-27°C to +52°C)

Altitude . . . . . Sea level to 20,000 feet

Dimensions . . . . . See figure 2-1

Weight (each unit) . . . . . Approximately 85 pounds

TABLE 1-3. MINIMUM NARROWBAND (CW) SENSITIVITY* - RMS ANALYSIS MODE

Bandwidth	Conducted (Two-Terminal 50-Ohm Input)			Radiated (Corrected for Antenna Factor)	
	uV	dBuV	-dBm	uV/m	dBuV/m
0.5 MHz	2.25	7	100	7.1 to 127	17 to 42
1.0 MHz	3.16	10	97	10.0 to 178	20 to 45
5.0 MHz	7.1	17	90	22.5 to 400	27 to 52
Full (≈10 MHz)	10	20	87	31.6 to 563	30 to 55

*See notes following table 1-4.

TABLE 1-4. MINIMUM BROADBAND (IMPULSIVE) SENSITIVITY* - PEAK ANALYSIS MODE

Bandwidth	Conducted (Two-Terminal 50-Ohm Input)		Radiated (Corrected for Antenna Factor	
	uV/MHz	dBuV/MHz	uV/m/MHz	dBuV/m/MHz
0.5 MHz	25.2	28	80.0 to 1420	38 to 63
1.0 MHz	17.8	25	56.4 to 1000	35 to 60
5.0 MHz	8	18	25.4 to 450	28 to 53
Full (≈10 MHz)	5.6	15	17.4 to 315	25 to 50

*Sensitivity defined as the minimum signal level required to produce a signal plus noise ratio of 3 dB. All data will be improved by 9.5 dB when referenced to minimum discernible signal (MDS), which is defined as the minimum signal level causing a 0.5 dB rise in indication.

Note that all radiated data combines both the sensitivity of the EMA-910 and the antenna factor (based on typical curves supplied by the manufacturer) of the Model 1200 Spiral Cone Antenna. Greater sensitivity can be attained by using horn feeds in place of the spiral cone antenna.

TABLE 1-5. REMOTE DATA CONNECTOR PIN INFORMATION

Pin Number	Information
	CAUTION The user of the equipment is strictly cautioned against using any of the voltages (other than the analog signal voltages) available at the REMOTE DATA connector for power sources without first obtaining written concurrence from EMC INSTRUMENTATION, Inc. Improper use of the available voltages can damage the equipment and void the warranty.
1	Data Evaluation Unit ground
2	Closure to ground indicates SWEEP MODE switch set to MANUAL
3	Closure to ground indicates SWEEP MODE switch set to SINGLE
4	Closure to ground indicates SWEEP MODE switch set to SECTOR
5	Memory clear inhibit input
6	Closure to ground indicates applied signal exceeds preset signal threshold level
7	Closure to ground indicates BANDWIDTH switch set to FULL
8	Closure to ground indicates BANDWIDTH switch set to 5 MHZ
9	Closure to ground indicates BANDWIDTH switch set to 1 MHZ
10	Closure to ground indicates BANDWIDTH switch set to 0.5 MHZ
11	Signal present inhibit input
12	Data Evaluation Unit ground
13	Lockout input
14	Call-up Unit command voltage input
15	Call-up Unit servo voltage
16	Closure to ground indicates BANDWIDTH switch set to 0.05 MHZ*
17.	Call-up Unit gain
18	Call-up Unit band switching voltage
19	Closure to ground indicates PEAK HOLD switch set to 5 SEC
20	Closure to ground indicates PEAK HOLD switch set to 0.5 SEC
21	Closure to ground indicates PEAK HOLD switch set to 0.1 SEC
22	Closure to ground indicates PEAK HOLD switch set to .01 SEC
23	+27 volt output
24	-5.6 volt output

*Optional bandwidth provided on special order only.

(Cont'd)

TABLE 1-5. REMOTE DATA CONNECTOR PIN INFORMATION (Cont'd)

Pin Number	Information
25	+180 volt output
26	Closure to ground indicates CALIBRATE pushbutton switch is depressed
27	Closure to ground indicates MULTIPLIER switch set to $X10^4$ +80 DB
28	Closure to ground indicates MULTIPLIER switch set to $X10^3$ +60 DB
29	Closure to ground indicates MULTIPLIER switch set to $X10^2$ +40 DB
30	Closure to ground indicates MULTIPLIER switch set to $X10^1$ +20 DB
31	Closure to ground indicates MULTIPLIER switch set to $X10^0$ +0 DB
32	Closure to ground indicates ANALYSIS MODE switch set to RMS
33	Closure to ground indicates ANALYSIS MODE switch set to SLIDEBACK
34	Closure to ground indicates ANALYSIS MODE switch set to PEAK
35	Analog Y output voltage
36	Closure to ground (recorder pen-drop command) when SWEEP MODE switch is set to SINGLE (and EMA-910 is scanning up-frequency) or SECTOR
37	-12 volt output
38	-24 volt output
39	+12 volt output
40	+24 volt output
41	Data Evaluation Unit ground
42	Closure to ground indicates BAND SWITCH set to BAND 4
43	Closure to ground indicates BAND SWITCH set to BAND 3
44	Closure to ground indicates BAND SWITCH set to BAND 2
45	Closure to ground indicates BAND SWITCH set to BAND 1
46	Analog X output voltage
47	Voltage polarity indicates scan direction
48	Data Evaluation Unit ground
49	Data Evaluation Unit ground
50	Data Evaluation Unit ground

1-37. ELECTRON TUBE, TRANSISTOR, CRYSTAL DIODE, FUSE AND INDICATOR LAMP COMPLEMENT.

1-38. The types and functions of the entire complement of electron tubes, transistors and diodes employed in the Frequency Selection Unit are listed in table 1-6. Similar information for the Data Evaluation Unit complement of transistors and diodes is contained in table 1-7. The fuse and indicator lamp complement of the EMA-910 is contained in table 1-8.

TABLE 1-6. FREQUENCY SELECTION UNIT ELECTRON TUBE, TRANSISTOR AND DIODE COMPLEMENT

Reference Symbol Number	Electron Tube, Transistor or Diode Type	Function
Main Frame		
CR101 and CR102	1N4003	Steering diodes
CR103 and CR104	1N4003	Transient suppression diodes
CR105 and CR106	1N4003	Steering diodes
CR107, CR108, CR112 and CR125 through CR129	1N4003	Transient suppression diodes
CR130	1N4003	Steering diode
CR131 and CR132	1N4003	Transient suppression diodes
CR133	1N4003	Steering diode
Q101 and Q102	2N1483	Servo driver amplifier
Afc Pulse Amplifier A101		
CR1	1N3044A	Voltage regulator
Q1	2N3565	Emitter follower
Q2	40327 (RCA)	Pulse amplifier
Clock Oscillator A102		
Q1 and Q2	2N4360	Astable multivibrator
Q3	2N3565	Amplifier
Q4	2N3569	Switch
Servo Bipolar Chopper/Preamplifier A103		
CR1 and CR2	1N4003	Steering diodes
CR3 and CR4	1N4003	Biasing diodes
Q1	2N3567	P/O Bipolar chopper
Q2	2N3638	P/O Bipolar chopper
Q3	2N3567	Phase splitter
Q4 and Q5	2N3567	Emitter followers

(Cont'd)

TABLE 1-6. FREQUENCY SELECTION UNIT ELECTRON TUBE, TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Electron Tube, Transistor or Diode Type	Function
Impulse Generator Driver A104		
CR1	1N4003	Transient suppression diode
Q1 and Q2	2N3638	Emitter-coupled astable multivibrator
Q3	2N3565	Emitter follower
Q4	2N3567	Switch
Afc Bipolar Chopper A106		
CR1 and CR2	1N498	Clamping diodes
Q1	2N3567	P/O Bipolar chopper
Q2	2N3638	P/O Bipolar chopper
Q4	2N3638	Emitter follower
Q5 and Q6	2N3638	Emitter-coupled astable multivibrator
Q7	2N3567	Emitter follower
240-MHz Preamplifiers A107, A108, A109 and A110		
Q1	A490 (Amperex)	240-MHz amplifier
Q2	2N3563	240-MHz amplifier
Band 1 Mixer A111 and Band 2 Mixer A112		
CR1 and CR2	1N416G	Balanced mixer
Band 3 Mixer A113		
CR1 and CR2	1N415G	Balanced mixer
Band 4 Mixer A114		
CR1 and CR2	DS190-MR (Sylvania)	Balanced mixer
Afc Operational Amplifier A115		
----------	SQ10 (Nexus)	Operational amplifier

(Cont'd)

TABLE 1-6. FREQUENCY SELECTION UNIT ELECTRON TUBE, TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Electron Tube, Transistor or Diode Type	Function
High Voltage Relay/Regulator A117		
Q1	2N3565	Beam current regulator
V1	0A2	Voltage regulator
V2 and V3	0B2	Voltage regulators
V4	0A2	Voltage regulator
V5 and V6	0B2	Voltage regulators
V7	0A2	Voltage regulator
Afc Adder A119		
CR1 through CR8	1N916	Afc adding detectors
CR9	1N4003	Biasing diode
CR10	1ZF18T10	Voltage limiter
CR11 through CR14	1N4006	Klystron protective diodes
Klystron Filament Supply A122		
CR1 through CR16	1N4003	Full-wave bridge rectifiers
Band 1 Tuner A124		
V1	6BM6	Klystron local oscillator
Band 2 Tuner A125		
V1	6BL6	Klystron local oscillator
Band 3 Tuner A126		
V1	5721	Klystron local oscillator
Band 4 Tuner A127		
V1	2K48	Klystron local oscillator

TABLE 1-7. DATA EVALUATION UNIT TRANSISTOR AND DIODE COMPLEMENT

Reference Symbol Number	Transistor or Diode Type	Function
Main Frame		
CR201 through CR203	1N4003	Steering diodes
CR204	1N4003	Transient suppression diode
CR205	1N4003	Steering diode
CR206 and CR207	1N4003	Transient suppression diodes
CR208 and CR209	1N4003	Steering diode
CR210	1N4003	Transient suppression diode
CR211 and CR212	1N4003	Steering diode
CR213 through CR217	1N4003	Transient suppression diodes
Audio Amplifier A201		
CR1	1N498	Pulse stretcher
Q1	2N3567	Emitter follower
Q2	2N3567	Phase splitter
Q3 and Q4	2N1481	Output amplifiers
+12/+24 Volt Regulator A202		
CR1	1N825	Voltage reference
Q1 and Q2	2N3567	Darlington emitter follower
Q3 and Q4	2N3567	Emitter-coupled difference amplifier
Q5	2N3567	Emitter follower
Q6	2N3565	Control amplifier
-12/-24 Volt Regulator A203		
Q1	2N3638	Emitter follower
Q2	2N3638A	Control amplifier
Q3	2N3638	Emitter follower
Q4	2N3638A	Control amplifier

(Cont'd)

TABLE 1-7. DATA EVALUATION UNIT TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor or Diode Type	Function
+27 Volt Regulator A204		
CR1	1N4003	Clamping diode
Q1	2N3638	Emitter follower
Q2 and Q3	2N3638	Emitter-coupled difference amplifier
Schmitt Trigger A205		
CR1	1N4003	Protective diode
Q1	2N4250	P/O Schmitt trigger
Q2 and Q3	2N3638	P/O Schmitt trigger
Q4 and Q5	2N3638	Emitter followers
Multivibrator/Integrator A206		
CR1	1N4003	Clamping diode
CR2 and CR3	1N4003	Steering diodes
CR4	1N4003	Clamping diode
CR5	1N4003	Steering diode
Q1 and Q2	2N3638	Monostable multivibrator
Q3	2N3638	Emitter follower
Q4	2N4250	Integrator
Floating ±28.5 Volt Regulator A207		
CR1	1N821	Voltage reference
Q1	2N3567	Emitter follower
Q2	2N3638	Emitter follower
Q3	2N3567	Control amplifier
Q4	2N3638	Control amplifier
Q5 and Q6	2N3567	Emitter-coupled difference amplifier
Q7	2N3638	Control amplifier

(Cont'd)

TABLE 1-7. DATA EVALUATION UNIT TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor or Diode Type	Function
Voltage Comparators A208, A213, A214, A215 and A216		
CR1	1N751	Biasing diode
Q1 through Q4	2N3569	Darlington emitter-coupled difference amplifier
Q5	2N3638	D-c amplifier
Q6	2N3569	Switch
Q7	2N3569	Constant current source
Memory Clear Pulse Amplifier A209		
CR1 through CR6	1N4003	Steering diodes
Q1	2N3565	Pulse amplifier
Q2	2N3569	Pulse amplifier
Q3	2N3638A	Pulse amplifier
Slideback/Video Stretch Amplifier A210		
CR1 and CR2	1N916	Pulse stretchers
Q1 and Q2	2N3565	Emitter-coupled difference amplifier
Q3	2N3638	D-c amplifier
Q4	2N3565	Emitter follower
Q5	40327 (RCA)	Switch
Q6	2N3565	Emitter follower
Q7	2N3567	Emitter follower
Q8	2N3565	Emitter follower
Afc Bipolar Pulse Stretcher A211		
CR1 and CR2	1N498	Pulse stretchers
CR4 through CR10	1N4003	Biasing diodes
Q1	2N3569	Emitter follower
Q2	2N3638A	Emitter follower
Q3 and Q4	2N3565	Darlington emitter follower
Q5 and Q6	2N3638A	Darlington emitter follower

(Cont'd)

TABLE 1-7. DATA EVALUATION UNIT TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor or Diode Type	Function
Scan Direction Control Flip-flop A212		
CR1	1N4003	Steering diode
CR2 and CR3	1N498	Steering diodes
CR4	1N4003	Steering diode
CR5 and CR6	1N4003	Recovery diodes
CR7	1N4003	Biasing diode
Q1 and Q2	2N3567	Bistable multivibrator
Q3	2N3567	Switch
Peak Operational Amplifier A217		
CR1	1N752	Biasing diode
CR2	FD100 (Fairchild)	Steering diode
CR3	FD100 (Fairchild)	Limiting diode
Q1	2N1613	Emitter follower
Q2	2N1613	Amplifier
Q3	2N1613	Emitter follower
Q4	2N1613	Amplifier
Q5	2N1613	Chopper
Q6	2N1132	P/O Differential amplifier
Q7	FT2484 (Fairchild)	P/O Differential amplifier
Q8 and Q9	2N1613	Darlington emitter follower
Q10	2N1132	Grounded-base amplifier
Q11 and Q12	2N657	Darlington emitter follower
Q13	2N741	Chopper
Q14 and Q15	2N1613	Astable multivibrator

(Cont'd)

TABLE 1-7. DATA EVALUATION UNIT TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor or Diode Type	Function
Metering Operational Amplifier A218		
----------	SQ10 (Nexus)	Operational amplifier
X Analog Operational Amplifier A219		
----------	SQ10 (Nexus)	Operational amplifier
60-MHz Linear I-f Amplifier A220		
CR1	1N916	Temperature compensation diode
CR2 and CR3	1N916	Gain control diodes
CR4	1N916	Temperature compensation diode
MC1	1550G (Motorola)	60-MHz amplifier
Q1 and Q2	2N3563	60-MHz amplifiers
Q3	2N2217	60-MHz amplifier
60-MHz Logarithmic I-f Amplifier A221		
CR1 through CR6	1N916	Video detectors
CR7 and CR8	1N4003	Bias and crossover distortion elimination diodes
MC1	uA702C (Fairchild)	Operational amplifier
Q1 through Q6	2N3563	60-MHz limiting amplifiers
Q7	2N697	P/O complementary-symmetry amplifier
Q8	2N3638	P/O complementary-symmetry amplifier
Q9	A490 (Amperex)	60-MHz amplifier
60-MHz I-f Amplifier/Afc Discriminator A222		
CR1 and CR2	1N916	Limiters
CR3 and CR4	1N916	Discriminator detectors
CR5 and CR6	1N4003	Bias and crossover distortion elimination diodes

(Cont'd)

TABLE 1-7. DATA EVALUATION UNIT TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor or Diode Type	Function
60-MHz I-f Amplifier/Afc Discriminator A222 (cont'd)		
CR7 and CR8	1N4003	Biasing diodes
MC1	uA702C (Fairchild)	Operational amplifier
Q1 through Q3	2N3563	60-MHz amplifiers
Q4	2N3567	P/O complementary-symmetry amplifier
Q5	2N3638	P/O Complementary-symmetry amplifier
Q6	2N3638	Emitter follower
Video Buffer/Peak Driver Amplifier A223		
CR1 and CR2	1N4003	Bias and crossover distortion elimination diodes
CR3	1N751	Biasing diode
CR4	1N4003	Biasing diode
CR5	1N3595	Gating diode
CR6	1N3595	Discharge diode
CR7	1N4003	Steering diode
CR8	1N4003	Temperature compensation diode
Q1	2N3569	P/O Complementary-symmetry amplifier
Q2	2N3638A	P/O Complementary-symmetry amplifier
Q3	2N3569	Emitter follower
Q4 and Q5	2N3565	Emitter-coupled difference amplifier
Q6	2N3638A	D-c amplifier
Q7	2N3569	Emitter follower
Q8	2N3565	Constant current source
240/60-MHz Mixer A225		
CR1	2350 (HP Assoc)	Mixer
Q1	A490 (Amperex)	60-MHz amplifier

(Cont'd)

TABLE 1-7. DATA EVALUATION UNIT TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor or Diode Type	Function
Crystal-controlled Oscillator A226		
Q1	2N3563	90-MHz oscillator
Q2	2N3563	Frequency doubler
400-Hz and High Voltage Supply A228		
BR1	SCBR30A (Semtech)	Full-wave bridge rectifier
BR2	SCBR20A (Semtech)	Full-wave bridge rectifier
CR1	1N609	Biasing diode
A1Q1	2N3569	Driver amplifier
A1Q2 and Q3	2N3638A	Emitter-coupled astable multivibrator
A1Q4	2N3569	Driver amplifier
Heat Sink A229		
Q1 and Q2	2N2492	Power oscillator
Q3 and Q4	2N2015	Power oscillator
Q5 and Q6	2N2492	Series regulators
Q7	2N2869	Emitter follower
Transistor and Diode Bracket A230		
CR1 through CR4	1N3210	Full-wave bridge rectifier
CR5 through CR210	1N1115	Full-wave bridge rectifiers
Q1 and Q2	2N1483	Series regulators
Q3 through Q5	2N2869	Series regulators
Q6	2N1483	Series regulator
Terminal Board A231		
CR1 through CR4	1N4003	Full-wave bridge rectifier

(Cont'd)

TABLE 1-7. DATA EVALUATION UNIT TRANSISTOR AND DIODE COMPLEMENT (Cont'd)

Reference Symbol Number	Transistor or Diode Type	Function
Terminal Board A232		
CR1	1N3048	Voltage regulator
CR2 and CR3	1N752	Voltage regulator
Terminal Board A233		
CR1 through CR4	1N4003	Steering diodes
CR5	1N751	Biasing diode
CR6	1N965A	Voltage regulator
+27 Volt Supply Overload Protector A234		
CR1	1N4003	Protective diode
Q1	2N3053	P/O Transient switch
Q2	2N1483	P/O Transient switch
Q3	2N3055	P/O Transient switch
Operational Amplifier Bracket A235		
CR1	1N751	Voltage reference
Connector Bracket A236		
CR1 and CR2	1N4003	Steering diodes
CR3	1N498	Clamping diode
CR4	1N498	Steering diode
CR5 and CR6	1N4003	Steering diodes
CR7	1N4003	Clamping diode
CR8 through CR13	1N4003	Steering diodes
Capacitor Bracket A238		
CR1	1N4006	Half-wave rectifier

TABLE 1-8. FUSE AND INDICATOR LAMP COMPLEMENT

Reference Symbol Number	Type	Function
FUSES		
F301 and F302	5-ampere, 3AG	Line protective fuses
F303	3/4-ampere, 3AG	+24 volt supply protective fuse
F304	3/4-ampere, 3AG	+12 volt supply protective fuse
F305	3/4-ampere, 3AG	-24 volt supply protective fuse
F306	3/4-ampere, 3AG	-12 volt supply protective fuse
F307	10-ampere, 3AG	+27 volt supply protective fuse
INDICATOR LAMPS		
DS201	NE51H	READY indicator lamp
DS202	NE51H	CROSSOVER indicator lamp
DS203	NE51H	SIGNAL PRESENT indicator lamp
DS204	NE51H	SLIDEBACK INDICATOR lamp
DS301	NE51H	POWER ON indicator lamp

SECTION II
OPERATION

2-1. GENERAL.

2-2 This section contains instructions for the installation and operation of the EMA-910. It is strongly recommended that the operator become thoroughly familiar with the material in this section before attempting to operate the equipment. Failure to do so may compromise the great versatility that has been engineered into the EMA-910.

2-3. INSTALLATION.

2-4. The EMA-910 is shipped complete and is ready for use upon receipt. No special installation procedures are required to prepare the equipment for use.

WARNING

BOTH THE MODEL EMA-910-10 FREQUENCY SELECTION UNIT AND THE MODEL EMA-910-11 DATA EVALUATION UNIT EACH WEIGH APPROXIMATELY 85 POUNDS. IT IS URGED THAT TWO PERSONS BE EMPLOYED WHEN UNPACKING, LIFTING, TRANSPORTING, INSTALLING OR PACKING THE EQUIPMENT.

2-5. UNPACKING. Unpacking and handling of the EMA-910 requires that the normal precautions applicable to the handling of sensitive electronic equipment be employed. Check the contents of all shipping containers against the packing invoice to ascertain that the shipment is complete.

2-6. INSPECTION. After the EMA-910 has been unpacked, examine the equipment for indications of damage which may have occurred during shipment. Check all front panel controls for freedom of movement, full travel and positive-detent locking. Note any evidence indicating that the equipment has sustained a severe mechanical shock. Check the condition of all accessories furnished as part of the order.

2-7. BENCH MOUNTING. The EMA-910 should be mounted on a sturdy, vibration-free surface. Place either the Model EMA-910-11 Data Evaluation Unit or the Model EMA-910-10 Frequency Selection Unit (hereafter referred to as the Data Evaluation Unit and Frequency Selection Unit, respectively) on the bench so that its front panel is a few inches from the edge of the bench. Carefully place the remaining unit atop the first so that the two rear feet of the top unit overhang the side panels of the bottom unit. Slowly slide the top unit back until the black nylon block on the underside of the top unit interlocks with the cleat on the top surface of the bottom unit.

2-8. CART MOUNTING. To mount the EMA-910 on a Model 3050 Instrument Cart, place either the Data Evaluation Unit or Frequency Selection Unit on the lower set of cart rails and slowly slide the unit to the rear of the cart until it comes to rest against the rear cushion. Place the reamining unit on the upper set of cart rails and slowly slide the unit to the rear of the cart.

2-9. RACK MOUNTING. To rack mount the EMA-910, remove the four feet (and associated mounting hardware) from each unit and replace the mounting hardware with 6-32 x 1/8 screws. Remove the black nylon block from the underside of each unit and replace the mounting hardware. Remove the four flathead screws and trim strip from each side panel rack mounting recess and, using the screws furnished with the flanges, install the rack mounting flanges in place of the trim strips. Mount the equipment in a standard 19-inch rack.

Note

The rack mounting flanges (EMC Part No. 80495-1) are not supplied unless specifically ordered. Mounting bolts are not furnished.

2-10. The recessed handles at the sides of each unit are removable for mounting the EMA-910 on rotary-detent rack slides. Consult the EMC Applications Engineering Department for detailed information regarding slide mounting.

2-11. The outline dimension drawings for both the bench and rack mounted versions of the EMA-910 are shown in figure 2-1. Note that all dimensions are in inches.

2-12. OPERATION.

2-13. The procedures for proper operation of the EMA-910 are contained in paragraphs 2-14 through 2-20.

2-14. OPERATING CONTROLS, INDICATORS, AND CONNECTORS. All controls, indicators and connectors necessary for the operation of the

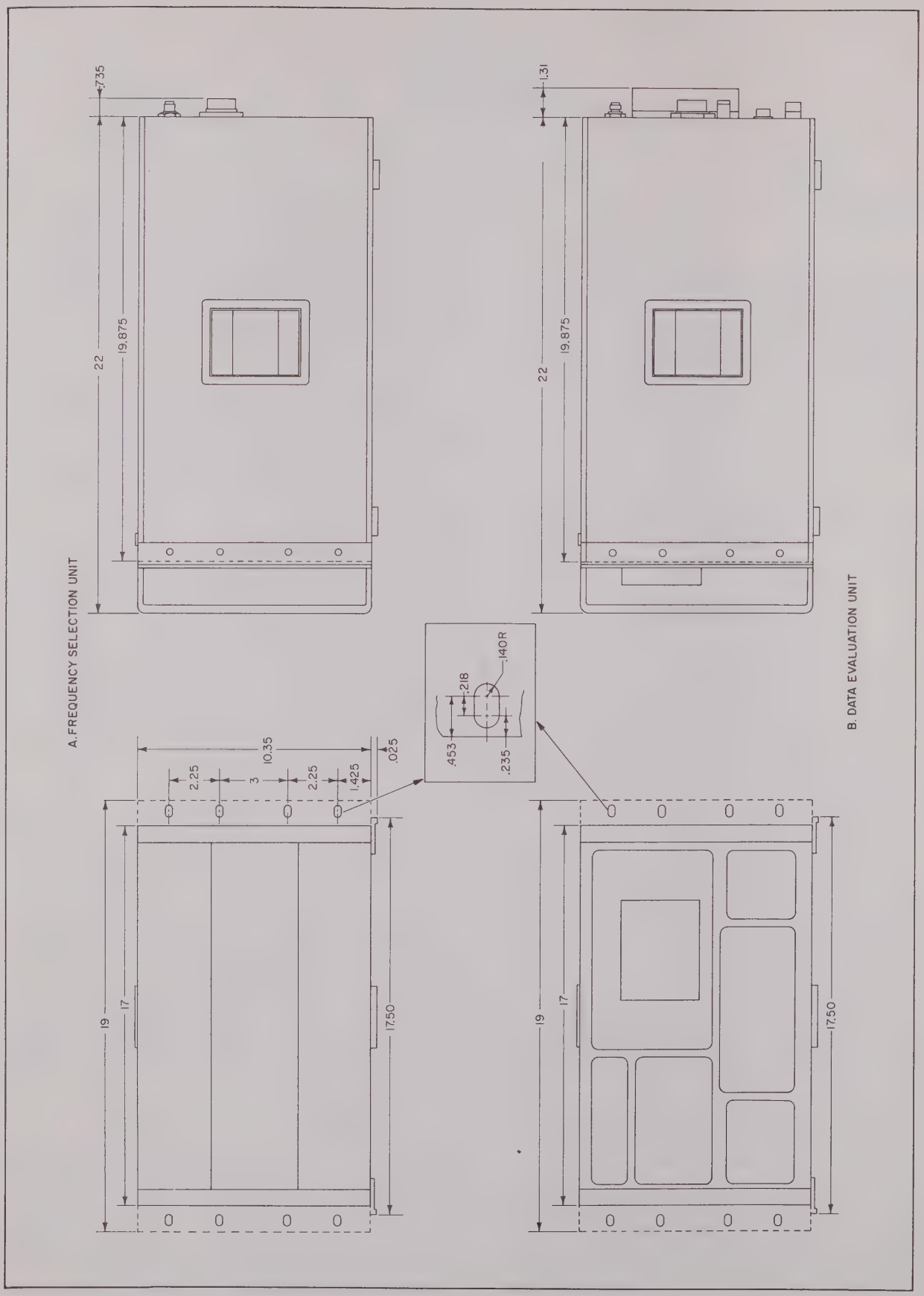


Figure 2-1. Outline Dimension Drawing

EMA-910 are functionally grouped on both the equipment front and rear panels as illustrated in figure 2-2; their functions are described in tables 2-1 and 2-2.

2-15. PREPARATION FOR USE. To prepare the EMA-910 for use, proceed as directed in the following steps.

a. Set the EMA-910 controls as listed in table 2-3.

b. Determine the nature of the power available at the source outlet. If necessary, set the 115V-230V switch (located on the Data Evaluation Unit rear panel) to the proper position. This is accomplished by removing the screw directly to the right of the switch, setting the switch to the position corresponding to the available source power and replacing the screw.

c. Interconnect the Frequency Selection Unit and Data Evaluation Unit as illustrated in figure 2-3.

WARNING

THE EMA-910 IS DESIGNED FOR OPERATION FROM A POLARIZED THREE-TERMINAL (ONE GROUND) POWER RECEPTACLE.

TO ELIMINATE THE POTENTIAL SHOCK HAZARD TO OPERATING PERSONNEL, A THREE-PRONG TO TWO-PRONG ADAPTER IS PROVIDED WITH THE EQUIPMENT. WHEN ONLY A TWO-TERMINAL POWER RECEPTACLE IS AVAILABLE, USE THE ADAPTER AND CONNECT ITS PIGTAIL LEAD TO POWER RECEPTACLE GROUND.

CAUTION

IF THE EMA-910 IS TO BE OPERATED FROM A 230-VOLT LINE, REPLACE BOTH 115/230V FUSES (RATED AT 5 AMPERES FOR 115-VOLT OPERATION) WITH FUSES RATED FOR 2.5 AMPERES @ 230 VOLTS.

d. Connect the six-foot a-c line cable (EMC Part No. 910-060) and adapter, if required, between the Data Evaluation Unit rear panel AC INPUT 115/230V 50-400HZ receptacle and the available line power receptacle.

e. Note the output meter pointer; it should deflect to an indication of 0 on the DB ABOVE 1 MICROVOLT scale. If necessary, adjust the output meter mechanical zero screwdriver control to obtain this deflection.

f. Set the power switch to ON; the POWER ON indicator lamp will illuminate upon application of line power and, after a delay of approximately 60 seconds, the READY indicator lamp will illuminate to signify that the EMA-910 is ready for operation.

g. Note the output meter pointer; it should deflect to an indication of 0 on the DB ABOVE 1 MICROVOLT scale. If necessary, adjust the METER ZERO screwdriver control to obtain this deflection.

h. Set the METER RESPONSE switch to FAST. The EMA-910 is now prepared for use.

TABLE 2-1. DATA EVALUATION UNIT OPERATING CONTROLS, INDICATORS AND CONNECTORS

Control, Indicator or Connector	Figure 2-2 Index Number	Function
POWER Grouping		
Power switch	1	Couples line power to the EMA-910.
READY indicator lamp	2	Illuminates approximately 60 seconds after application of line power, indicating that the EMA-910 is ready for use.
POWER ON indicator lamp	3	Illuminates upon application of line power to the EMA-910.
115/230V 5 AMP fuseholders	4	House line protective fuses.

(Cont'd)

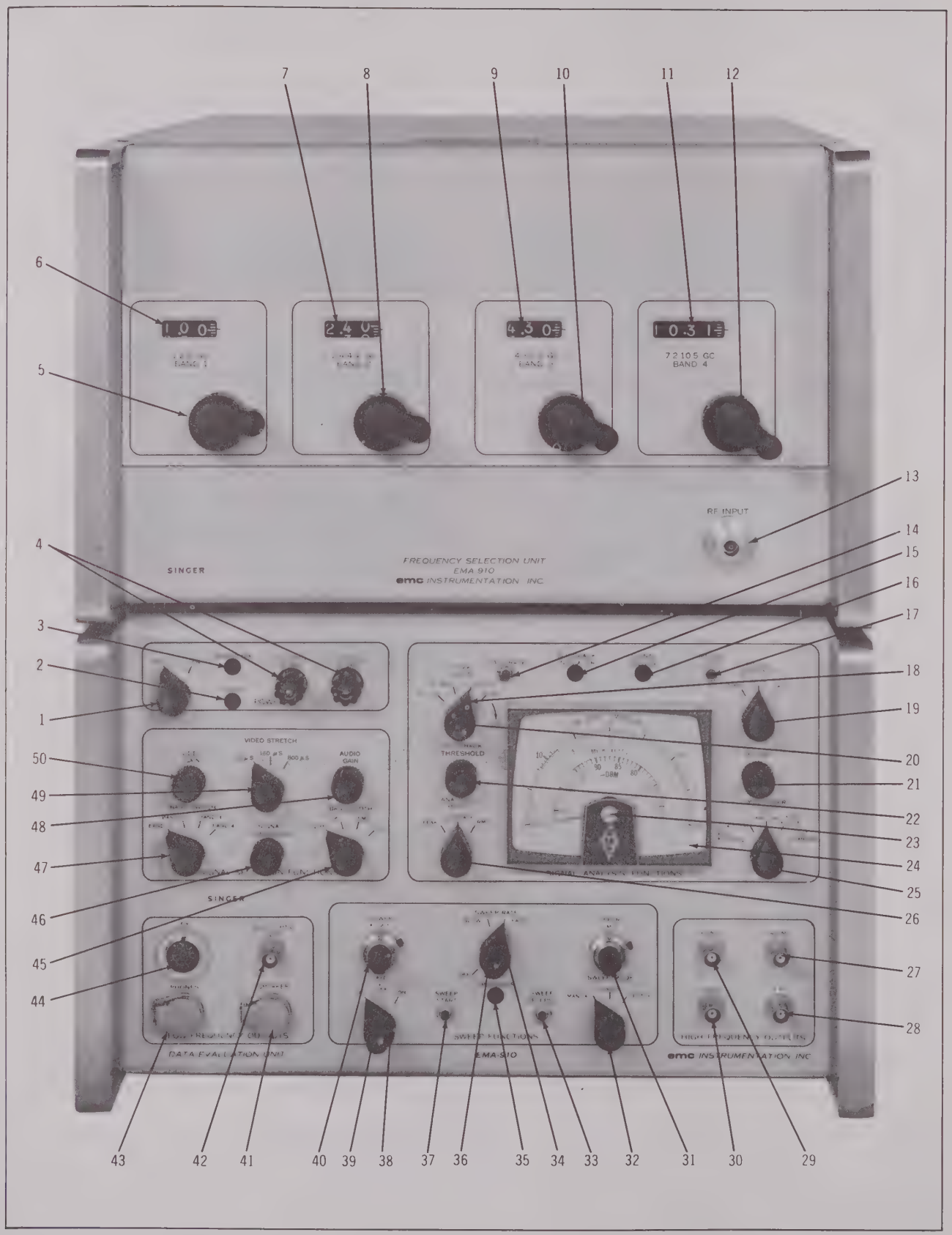


Figure 2-2. Operating Controls, Indicators and Connectors, Sheet 1 of 2 (Tables 2-1 and 2-2)

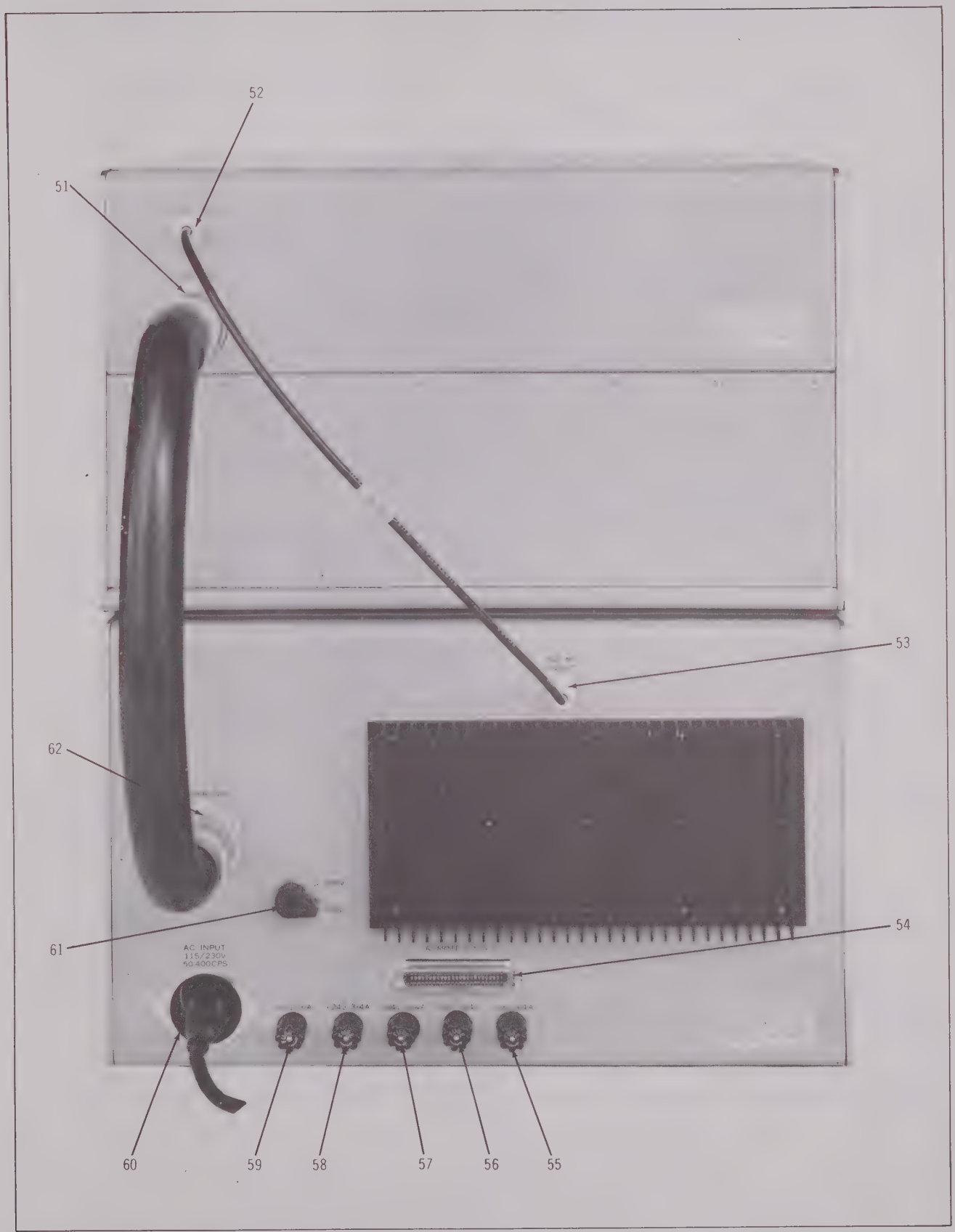


Figure 2-2. Operating Controls, Indicators and Connectors, Sheet 2 of 2 (Tables 2-1 and 2-2)

TABLE 2-1. DATA EVALUATION UNIT OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control Indicator or Connector	Figure 2-2 Index Number	Function
SWEEP FUNCTIONS Grouping		
UPPER LIMIT control	31	Ten-turn potentiometer which enables the operator to select the upper frequency limit of the frequency sector to be scanned. A locking lever is provided to secure the control at the selected setting.
SWEEP MODE switch	32	Enables the operator to select the scan mode of the EMA-910, as follows: MANUAL - All automatic scanning circuitry is inoperative and tuning to an applied signal can be accomplished only by setting the BAND SWITCH to the desired band and manually rotating the corresponding tuning control; SINGLE - Automatic scanning circuitry is activated and, after the SWEEP START pushbutton switch is momentarily depressed, the EMA-910 scans up frequency (at a scanning rate determined by the settings of the SWEEP RATE switch and control) until the upper frequency limit of the sector is reached, at which point the scanning mechanism reverses direction and scans down frequency at maximum speed, automatically stopping at the low frequency limit of the sector. This cycle can be repeated by once again momentarily depressing the SWEEP START pushbutton switch. SECTOR - Automatic scanning circuitry is activated and, after the SWEEP START pushbutton switch is momentarily depressed, the EMA-910 scans continuously between the upper and lower sector limits (at a scanning rate determined by the settings of the SWEEP RATE switch and control), automatically reversing direction when the scan limit is reached. This cycle can be terminated only by setting the SWEEP MODE switch to any position other than SECTOR.
SWEEP REVERSE pushbutton switch	33	Enables the operator to interrupt the scanning cycle during single scan operation (causing the EMA-910 to scan down frequency at maximum speed until the low frequency limit of the sector is reached and then stopping) or to reverse the scan direction at any point during normal sector scan operation.
SWEEP RATE switch	34	Enables the operator to select either slow (0 to approximately 7.5 MHz/sec) or fast (0 to approximately 75 MHz/sec) sweep rates, as determined by the setting of the SWEEP RATE control.

(Cont'd)

TABLE 2-1. DATA EVALUATION UNIT OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator or Connector	Figure 2-2 Index Number	Function
SWEEP FUNCTIONS Grouping (Cont'd)		
CROSSOVER indicator lamp	35	Flashes when the operator inadvertently sets the UPPER LIMIT control to a frequency lower than that to which the LOWER LIMIT control is set, indicating that the scanning circuitry is inoperative until this condition is rectified.
SWEEP RATE control	36	Permits vernier adjustment of either the slow or fast scan sweep rates.
SWEEP START push-button switch	37	Momentary depression initiates single or sector scan operation.
AFC switch	38	When set to ON, incorporates automatic electronic and/or mechanical feedback loop which enables the EMA-910 to track drifting signals. This tracking capability is operative only within the frequency range of the selected tuner band.
AFC Δf control	39	Vernier control employed to optimize afc operation when using narrow bandwidths.
LOWER LIMIT control	40	Ten-turn potentiometer which enables the operator to select the lower frequency limit of the frequency sector to be scanned. A locking lever is provided to secure the control at the selected setting.
LOW FREQUENCY OUTPUTS Grouping		
SPEAKER jack	41	Couples recovered audio-modulation content of applied signal to an external 4-ohm speaker such as the Model 3020 Speaker.
STRETCHED VIDEO connector	42	Couples the stretched video (amplitude-modulation content) signal to auxiliary test equipment such as an oscilloscope.
PHONES jack	43	Couples the recovered audio-modulation content of applied signals to an external 600-ohm headset such as the Model 3010 Earphones.
X-Y connector	44	Connector at which both frequency (X) and amplitude (Y) analog voltages are available for application to external pen recorders when a permanent record of information is required.

(Cont'd)

TABLE 2-1. DATA EVALUATION UNIT OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator or Connector	Figure 2-2 Index Number	Function
SIGNAL SELECTION FUNCTIONS Grouping		
BANDWIDTH switch	45	Permits the operator to select any one of three calibrated (0.5, 1.0 and 5 MHz) and one uncalibrated (approximately 10 MHz) bandwidths.
SIGNAL THRESHOLD control	46	Permits the operator to set a reference level on the meter scale. Any applied signal causing the meter pointer to deflect beyond this preset scale indication will illuminate the SIGNAL PRESENT indicator lamp to alert the operator to the presence of this signal. When the EMA-910 is set for continuous sector scan operation and the AFC switch is set to ON, interception of a signal exceeding this preset level will automatically interrupt the scan.
BAND SWITCH	47	Allows the operator to select the appropriate tuner during manually-tuned operation of the EMA-910.
AUDIO GAIN control	48	Adjusts the volume of the recovered audio-modulation signal coupled to both the PHONES and SPEAKER jacks.
VIDEO STRETCH switch	49	Enables the operator to select video stretch times of 30, 160 or 800 microseconds to match the response time of auxiliary recording equipment to video signals.
VIDEO GAIN control	50	Adjusts the level of the signal coupled to the STRETCHED VIDEO connector.
Rear Panel		
240 MHZ INPUT connector	53	Connector which couples the 240-MHz first i-f signal from the Frequency Selection Unit to the i-f circuitry within the Data Evaluation Unit.
REMOTE DATA connector	54	Fifty pin connector which couples (a) voltages indicative of signal levels, (b) closures to ground corresponding to EMA-910 operating modes, (c) control and command voltages and (d) operating voltages (see table 1-5) to accessory equipment such as the Model 8010 Ten Channel Call-up Unit and the Model 3100 Digital Display Unit.
-12V 3/4A fuseholder	55	Houses protective fuse for internal -12 volt supply.
+12V 3/4A fuseholder	56	Houses protective fuse for internal +12 volt supply.
-24V 3/4A fuseholder	57	Houses protective fuse for internal -24 volt supply.
+24V 3/4A fuseholder	58	Houses protective fuse for internal +24 volt supply.
+27V 10A fuseholder	59	Houses protective fuse for internal +27 volt supply.

(Cont'd)

TABLE 2-1. DATA EVALUATION UNIT OPERATING CONTROLS, INDICATORS AND CONNECTORS (Cont'd)

Control, Indicator or Connector	Figure 2-2 Index Number	Function
Rear Panel (Cont'd)		
AC INPUT 115/230V 50-400HZ receptacle	60	Polarized connector through which a-c line power is applied to the EMA-910.
115V-230V switch	61	Allows the EMA-910 to operate from either 115 volt or 230 volt line power.
POWER OUT connector	62	Fifty-five pin connector which couples operating power, control and command voltages to and from the Frequency Selection Unit.

TABLE 2-2. FREQUENCY SELECTION UNIT OPERATING CONTROLS, INDICATORS AND CONNECTORS

Control, Indicator or Connector	Figure 2-2 Index Number	Function
Front Panel		
BAND 1 tuning control	5	Manual tuning control for band 1 tuner.
1-2.5 GHZ indicator	6	Indicates frequency to which the band 1 tuner is set.
2.4-4.4 GHZ indicator	7	Indicates frequency to which the band 2 tuner is set.
BAND 2 tuning control	8	Manual tuning control for band 2 tuner.
4.3-7.3 GHZ indicator	9	Indicates frequency to which the band 3 tuner is set.
BAND 3 tuning control	10	Manual tuning control for band 3 tuner.
7.2-10.5 GHZ indicator	11	Indicates frequency to which the band 4 tuner is set.
BAND 4 tuning control	12	Manual tuning control for band 4 tuner.
RF INPUT connector	13	Front panel connector which couples the applied r-f signal to the EMA-910 tuners.
Rear Panel		
POWER IN connector	51	Fifty-five pin connector which couples operating power, control and command voltages to and from the Data Evaluation Unit.
240 MHZ OUTPUT connector	52	Connector which couples the 240-MHz first i-f output of the Frequency Selection Unit to the Data Evaluation Unit.

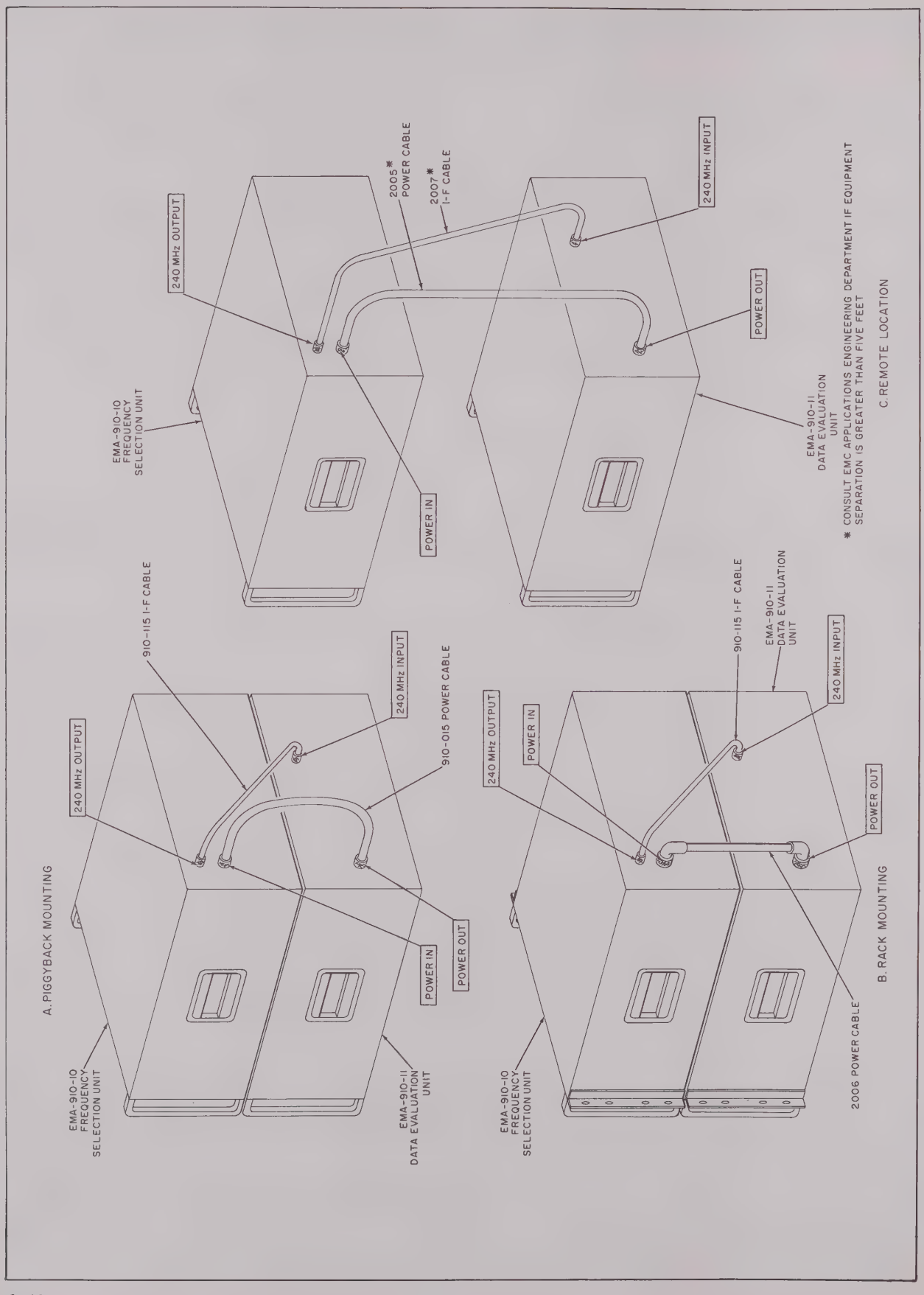


Figure 2-3. Interconnecting Cabling Diagram

TABLE 2-3. INITIAL CONTROL SETTINGS

Control	Setting
Data Evaluation Unit	
Power switch	Off
METER RESPONSE switch	ZERO
IF GAIN control	Mid-range
MULTIPLIER switch	X10° +0 DB
ANALYSIS MODE switch	PEAK
SIGNAL THRESHOLD control	Fully clockwise
SLIDEBACK THRESHOLD control	Fully counterclockwise
SWEEP MODE switch	MANUAL
AFC switch	OFF
AFC Δf control	Mid-range
PEAK HOLD switch	.01 SEC
PEAK HOLD control	CAL (fully clockwise)
VIDEO GAIN control	Mid-range
VIDEO STRETCH switch	30uS
BAND SWITCH	BAND 1
BAND WIDTH switch	5 MHZ
SWEEP RATE switch	SLOW
SWEEP RATE control	OFF (Fully counterclockwise)
LOWER LIMIT control	Fully counterclockwise
UPPER LIMIT control	Fully clockwise
Frequency Selection Unit	
Tuning controls	To obtain frequency indicator readings corresponding to the low-frequency limit of each tuner

2-16. MANUALLY TUNED OPERATION. To search for the presence of a signal by manual tuning of the equipment, prepare the EMA-910 for use as detailed in paragraph 2-15 and then continue as directed in the following steps.

Note

If the applied signal frequency is known, set the BAND SWITCH to the band in which the frequency lies. Disregard all band switching instructions in the following procedure and mentally change all band references to that of the tuner in which the signal lies.

a. With no signal being applied to the EMA-910, note the output meter pointer deflection; this corresponds to inherent internal noise.

b. Couple the signal under analysis (antenna output or output of device under test) to the RF INPUT connector.

c. Rotate the BAND 1 tuning control clockwise in search of the presence of a signal component. Note that, in the absence of a signal component, the output meter pointer will smoothly fluctuate with rotation of the tuning control. Interception of a signal component, however, will cause the output meter pointer to rise sharply upscale. Continue rotating the tuning control clockwise to obtain a maximum on-scale output meter indication. Should the output meter pointer deflect to an off-scale indication before reaching a maximum, rotate the MULTIPLIER switch one step clockwise. Alternately rotate the tuning control clockwise and resetting the MULTIPLIER switch as required until a maximum on-scale output meter indication is obtained.

d. Set the BAND WIDTH switch to 1 MHZ and carefully adjust the tuning control to once again obtain a maximum output meter indication.

e. Note the frequency to which the EMA-910 is tuned and refer to figure 2-4.

f. Momentarily depress the CALIBRATE pushbutton switch and, while the switch is held depressed, adjust the IF GAIN control to obtain the output meter DB ABOVE 1 MICROVOLT scale indication specified in figure 2-4 at the frequency to which the EMA-910 is tuned.

g. Release the CALIBRATE pushbutton switch after adjusting the IF GAIN control.

Note

The EMA-910 is now calibrated at the frequency indicated. Do <u>not</u> re-adjust the setting of the IF GAIN control when making measurements at this frequency. Should the EMA-910 be tuned to another frequency, the equipment must be recalibrated as directed in step f.

h. Note both the output meter indication (on the DB ABOVE 1 MICROVOLT scale) and the dB indication of the MULTIPLIER switch (e.g., +20 DB).

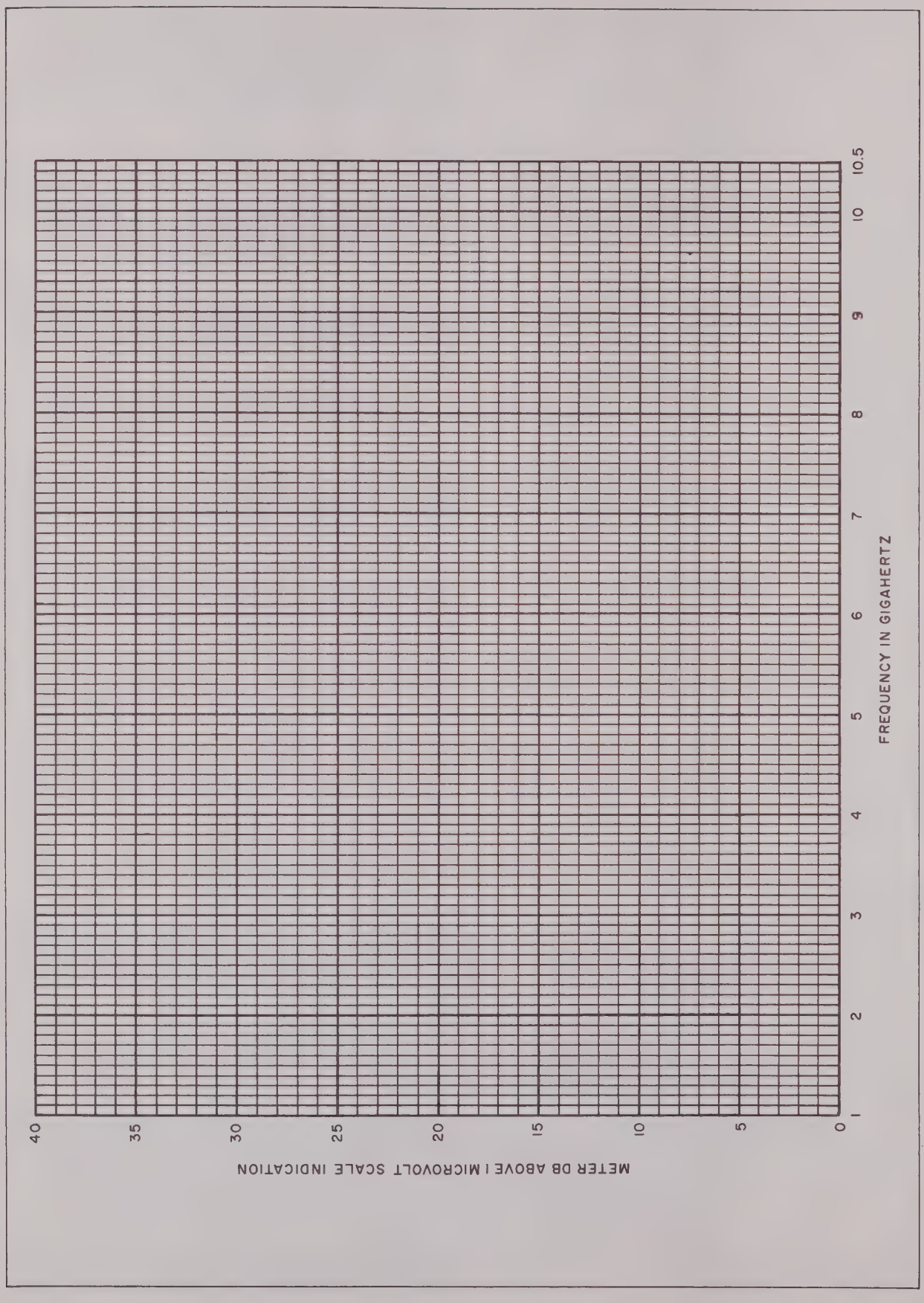


Figure 2-4. Gain Calibration Curve

i. Set the BAND WIDTH switch to 5 MHZ (adjusting the setting of the MULTIPLIER switch, if necessary, to maintain an on-scale output meter indication) and repeat step h.

j. Set the ANALYSIS MODE switch to RMS, the BAND WIDTH switch to 1 MHz and, if necessary, adjust the setting of the MULTIPLIER switch to maintain an on-scale output meter indication. Repeat step h.

k. Refer to table 2-4 to determine the characteristics of the intercepted signal component and the proper setting of the ANALYSIS MODE switch required to evaluate its level.

l. Set the ANALYSIS MODE switch to the position compatible with the characteristics of the applied signal (see table 2-4).

m. Note the sum of both the output meter indication (on the DB ABOVE 1 MICROVOLT scale) and the dB indication of the MULTIPLIER switch. The magnitude of the intercepted signal component present at the RF INPUT connector is equal to the algebraic sum of the output meter DB ABOVE 1 MICROVOLT scale indication and the dB indication of the MULTIPLIER switch and is expressed in dB above 1 microvolt (for narrowband signals) or dB above 1 microvolt/megahertz (for broadband signals);

OR

Note the output meter indication (on the MICROVOLTS scale) and the decade factor (e.g., $X10^3$) of the MULTIPLIER switch. The magnitude of the intercepted signal component present at the RF INPUT connector is equal to the product of the output meter MICROVOLTS scale indication and the MULTIPLIER switch decade factor and is expressed in microvolts (for narrowband signals) or microvolts/-megahertz (for broadband signals).

OR

Note the output meter indication (on the -DBM scale) and the dB indication of the MULTIPLIER switch. The power level of the intercepted signal component present at the RF INPUT connector is equal to the algebraic sum of the output meter -DBM scale indication (a negative number) and the dB indication of the MULTIPLIER switch and is expressed in ± dBm (for narrowband signals) or ± dBm/megahertz (for broadband signals).

Note

If the intercepted signal component coupled to the RF INPUT connector is the output of an antenna, the radiated field strength can be evaluated as the sum of the following:

(1) The intercepted signal component level (in dB above 1 uV or dB above 1 uV/MHz)

(2) The attenuation of the cable coupling the antenna output to the RF INPUT connector (see figure 2-5 for the attenuation of six-foot r-f cable - EMC Part No. 910-160) and

(3) The antenna factor of the calibrated antenna employed (see figure 2-6 for the antenna factors for the Models 1010, 1020, 1030 and 1040 Horn Antennas).

The resulting field strength is expressed in dB above 1 uV/meter (for narrowband signals) or dB above 1 uV/MHz/meter (for broadband signals).

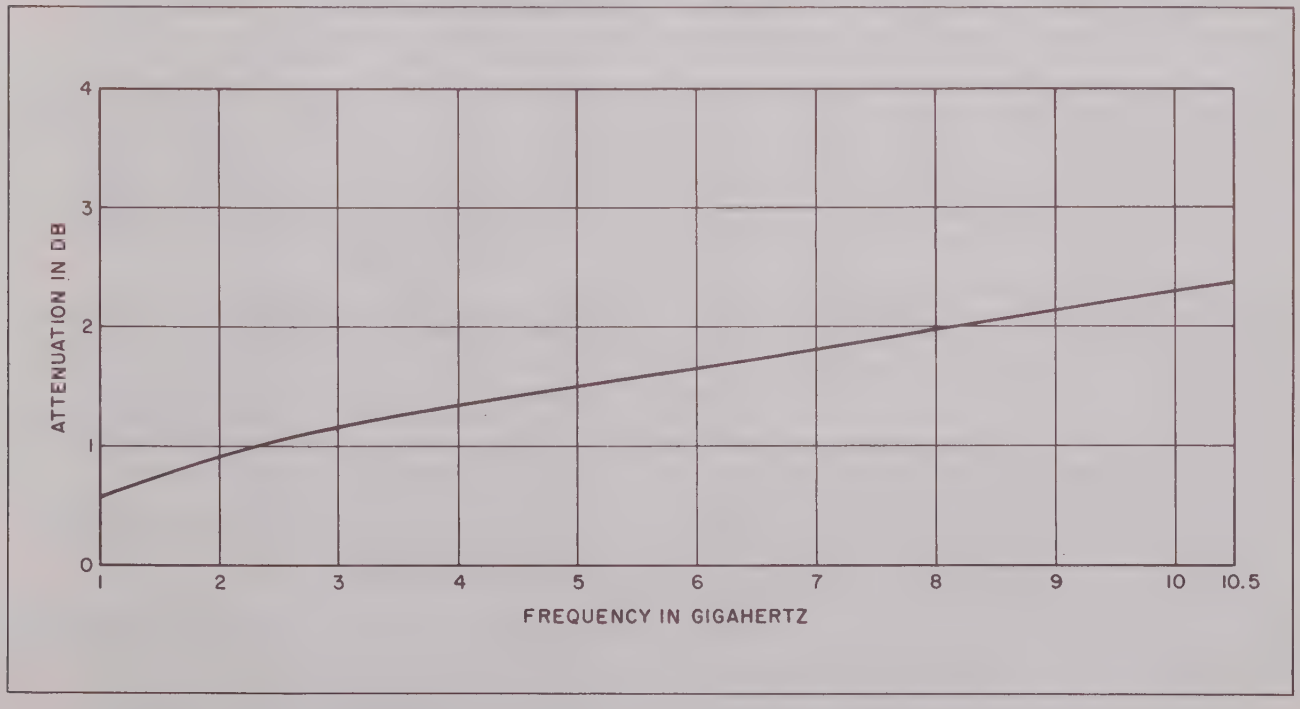


Figure 2-5. Attenuation Vs. Frequency Characteristics, 6-Foot R-f Cable 910-160

TABLE 2-4. SELECTION OF ANALYSIS MODE AS A FUNCTION OF APPLIED SIGNAL CHARACTERISTICS*

Sum of Output Meter DB ABOVE 1 MICROVOLT Scale Indication and MULTIPLIER Switch DB Indication			Signal Characteristic and Applicable Analysis Mode
1 MHz Bandwidth PEAK Analysis Mode	5 MHz Bandwidth PEAK Analysis Mode	1 MHz Bandwidth RMS Analysis Mode	
Reference	Same as reference	Same as reference	Signal is narrowband (cw). Use RMS analysis mode.
Reference	Same as reference	0 to 9 dB below reference	Signal is narrowband (amplitude modulated). Use RMS and/or PEAK analysis mode.
Reference	Same as reference	Greater than 9 dB below reference	Signal is narrowband (pulsed cw with duty cycle of less than 50%). Use PEAK analysis mode.
Reference	Less than 14 dB greater than reference	----------	Signal is of intermediate bandwidth. Use PEAK analysis mode.
Reference	14 dB greater than reference	----------	Signal is broadband. Use PEAK analysis mode.

*Applied signal level is at least 10 dB above noise.

n. Set the BAND WIDTH switch to 5 MHZ and the ANALYSIS MODE switch to PEAK.

o. Continue rotating the tuning control clockwise. If no other signal component is adjacent to that just intercepted, the output meter pointer will start to drop downscale as the signal component leaves the EMA-910 passband. Continue rotating the tuning control clockwise, while setting the MULTIPLIER switch counterclockwise in one step increments, until the output meter once again indicates inherent internal noise (with the MULTIPLIER switch set to $X10^{O}$ + 0 DB) or the pointer again rises upscale to indicate the interception of another signal component.

p. Repeat steps c through m, setting the BAND SWITCH to the next higher band as required, until all signal components within the frequency range from 1.0 to 10.5 GHz have been intercepted and evaluated.

2-17. AFC OPERATION. In some applications where a single frequency signal is under evaluation for a relatively long period of time (i.e., when making antenna pattern measurements), frequency drift of the signal source may result in the applied signal falling from the EMA-910 passband. This loss of signal can be prevented by incorporating the automatic frequency control capability of the equipment as directed in the following steps.

a. Tune the EMA-910 to the signal as detailed in steps a through l of paragraph 2-16.

b. Set the AFC switch to ON and rotate the SIGNAL THRESHOLD control fully counterclockwise; the SIGNAL PRESENT indicator lamp will illuminate and the EMA-910 will remain tuned to the applied signal despite its frequency drift.

Note

The afc capability automatically compensates for applied signal frequency drift as long as the signal coupled to the EMA-910 remains within the frequency limits of the selected tuner. Should the applied signal frequency drift beyond these limits, the afc capability will not be operative.

2-18. SLIDEBACK PEAK MEASUREMENTS. In some applications it may be required to evaluate the peak level of an applied signal by the slideback technique. This can be accomplished by first tuning the EMA-910 to the applied signal as directed in steps a through g of paragraph 2-15 and then continuing as described in the following steps.

a. Set the ANALYSIS MODE switch to SLIDEBACK. Note that the SLIDEBACK INDICATOR lamp is illuminated.

b. Carefully rotate the SLIDEBACK THRESHOLD control clockwise until the SLIDEBACK INDICATOR lamp just becomes extinguished.

c. Note the output meter indication and the indication of the MULTIPLIER switch. Determine the

applied signal level in the same manner as in step m of paragraph 2-15.

2-19. HIGH LEVEL SIGNAL INDICATION. In some applications it may be required to alert the operator to the presence of a signal which exceeds a predetermined level. This can be accomplished in the following manner.

a. With no signal applied to the RF INPUT connector, set the ANALYSIS MODE switch to PEAK, tune the EMA-910 to the desired frequency and calibrate the equipment.

b. With the SLIDEBACK THRESHOLD control rotated fully counterclockwise and the SIGNAL THRESHOLD control rotated fully clockwise, set the ANALYSIS MODE switch to SLIDEBACK.

c. Determine the signal level (in dB above 1 uV) which, when exceeded, is to alert the operator. Note that this signal level must be well above inherent equipment noise.

d. Set the MULTIPLIER switch to that position which, if the critical signal level were applied, would produce an on-scale output meter indication.

e. Carefully rotate the SLIDEBACK THRESHOLD control clockwise to obtain an output meter indication corresponding to the critical level.

EXAMPLE: If the critical signal level is to be 98 dB above 1 uV, set the MULTIPLIER switch to $X10^4$ + 80 DB and adjust the SLIDEBACK THRESHOLD control to obtain an output meter DB ABOVE 1 MICROVOLT scale indication of 18.

f. Carefully rotate the SIGNAL THRESHOLD control counterclockwise until the SIGNAL PRESENT indicator lamp just illuminates.

g. Set the ANALYSIS MODE switch to either PEAK or RMS, as required. Note that the SIGNAL PRESENT indicator lamp becomes extinguished.

h. Couple the signal under test to the RF INPUT connector. Should the applied signal level exceed the preset critical value, the SIGNAL PRESENT indicator lamp will illuminate to alert the operator.

2-20. SEMIAUTOMATIC SINGLE SECTOR SCAN OPERATION. To program the EMA-910 for semiautomatic scan operation to meet the requirements of standard military and/or commercial RFI specifications, prepare the equipment for operation as described in paragraph 2-15 and then continue as directed in the following steps.

Note

This capability of the EMA-910 requires the use of an auxiliary x-y recorder which accepts a remote switch closure to ground as a pen drop command.

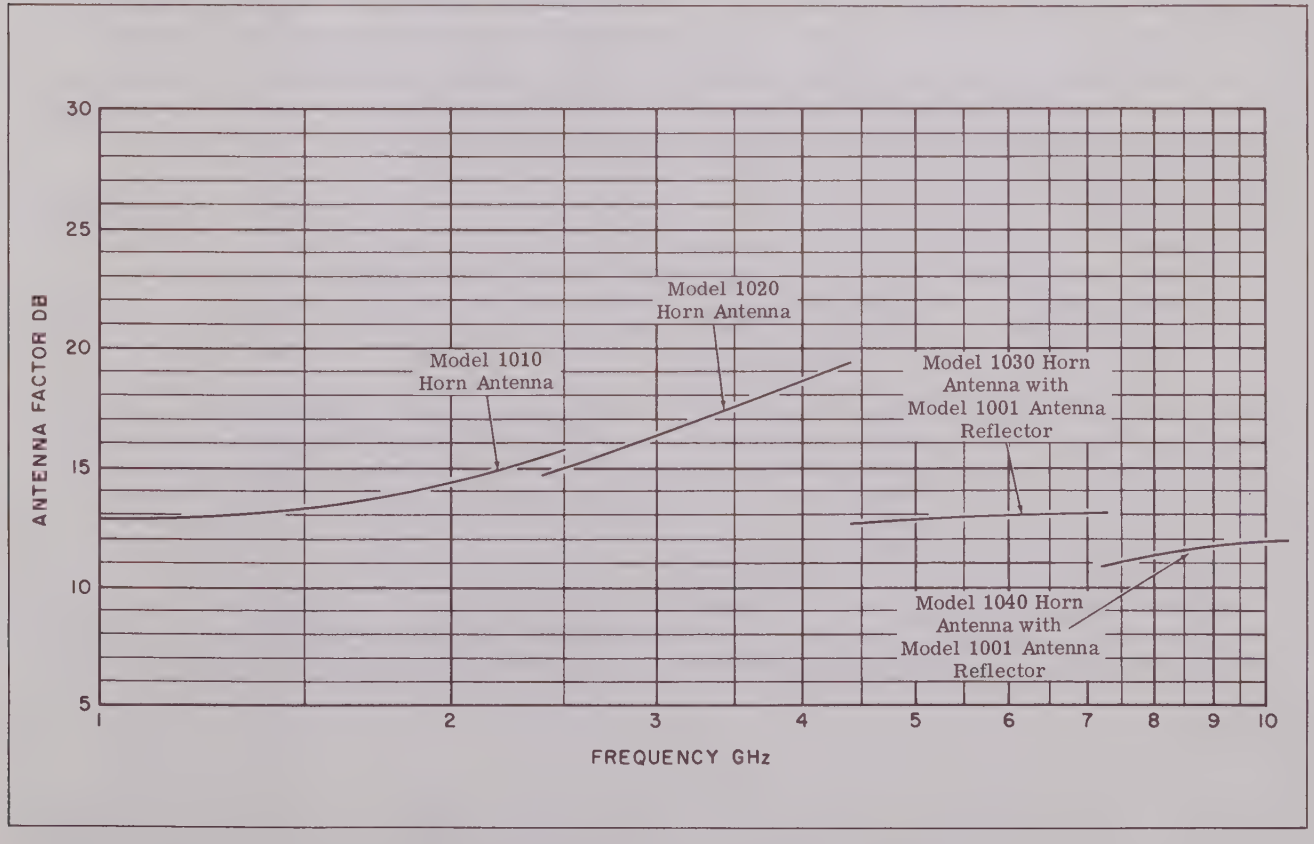


Figure 2-6. Antenna Factor Vs. Frequency Characteristics, Models 1010, 1020, 1030 and 1040 Horn Antennas

a. Couple an x-y recorder to the X-Y connector, as illustrated in figure 2-7, using the Model 2002 X-Y Recorder Cable. Adjust the recorder for remote pen drop command.

b. Adjust the LOWER LIMIT and UPPER LIMIT controls for the desired scan low and high frequency limits, respectively. Note that the outer dial of each control is calibrated to read directly in gigahertz (GHz) and the inner dial in megahertz (MHz). Thus, to adjust either control for a limit frequency of 4.55 GHz, set the control to obtain an outer dial indication of 4 and an inner dial indication of 55. A locking lever is provided to secure each control at the selected limit frequency.

Note

Should the operator inadvertently set the UPPER LIMIT control to a frequency below that to which the LOWER LIMIT control is set, the CROSSOVER indicator lamp will flash to alert the operator to this improper setting of the controls. The scan cycle cannot be initiated while this crossover condition exists.

c. Insert a sheet of graph paper into the recorder. (For the convenience of the user, multiple reproducible precalibrated graph forms for use in conjunction with a standard 8-1/2 x 11 inch x-y recorder are provided at the end of this section. A sample of this form is illustrated in figure 2-8.)

d. Set the METER RESPONSE switch to ZERO.

e. With the BAND SWITCH set to BAND 1 and the band 1 tuning control adjusted to obtain a 1-2.5 GHZ indicator reading of 1.00, adjust the recorder x zero control to position the lifted pen directly over the vertical frequency line corresponding to 1 GHz.

f. Adjust the recorder y zero control to position the lifted pen directly over the horizontal line corresponding to an output meter DB ABOVE 1 MICROVOLT scale indication of 0.

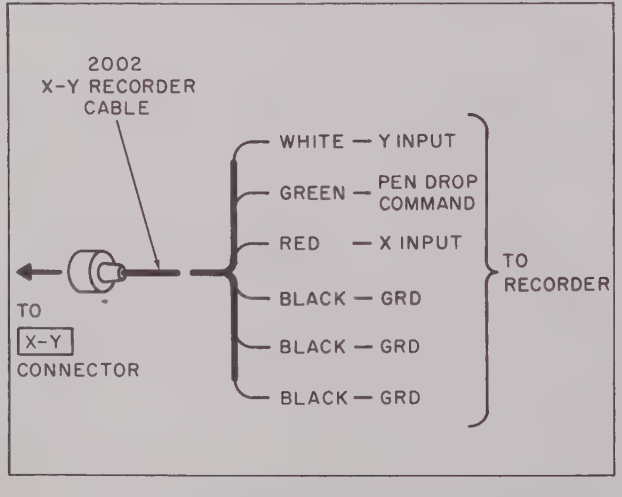


Figure 2-7. Recorder Interconnection Diagram

g. Set the METER RESPONSE switch to FAST, depress the CALIBRATE pushbutton switch and, while holding the switch depressed, adjust the IF GAIN control to obtain the output meter indication specified in figure 2-4 for a frequency of 1 GHz.

h. While still holding the CALIBRATE pushbutton switch depressed, adjust the recorder y sensitivity control to vertically displace the position of the lifted pen to obtain the same indication as that for step g. Release the CALIBRATE pushbutton switch.

i. Due to interaction between the recorder y zero and y sensitivity controls, it may be necessary to repeat steps d, f, g and h several times to obtain the proper pen positions.

j. Set the BAND SWITCH to the band in which the low frequency limit lies and adjust the corresponding tuning control to obtain an indicator reading equal to the low frequency scan limit.

k. Adjust the recorder x zero control to position the lifted pen over the vertical line which corresponds to the low limit frequency.

l. Set the BAND SWITCH to the band in which the high frequency limit lies and adjust the corresponding tuning control to obtain an indicator reading equal to the high frequency scan limit.

m. Adjust the recorder x sensitivity control to position the lifted pen over the vertical line which corresponds to the high limit frequency.

n. Due to interaction between the recorder x zero and x sensitivity controls, it may be necessary to repeat steps j through m several times to obtain the proper pen positions.

o. Set the BAND SWITCH to the band in which the low frequency limit lies.

p. Set the tuning control of the tuner in which the high frequency limit lies fully counterclockwise. (If the selected low and high frequency scan limits both lie within the frequency range of one tuner, rotate the tuning control to obtain an indicator reading equal to the low limit frequency.)

q. Set the SWEEP RATE switch and control for the desired scan time. Note that, for a given setting of both the SWEEP RATE switch and control, the time required to scan across each tuner is different but the scanning rates are approximately equal (i.e., the time required to scan across the band 1 tuner will be less than that for the band 4 tuner).

r. Set the PEAK HOLD switch as required. A peak hold time of 0.5 seconds is recommended for most applications.

s. Set the MULTIPLIER switch to $X10^4 + 80$ DB.

t. Set the SWEEP MODE switch to SINGLE.

u. Couple the signal under analysis to the RF INPUT connector.

Note

If the EMA-910 is to be employed to evaluate radiated field strength over a frequency range beyond the limits of any one tuner, the Model 1200 Spiral Cone Antenna may be used.

v. Momentarily depress the SWEEP START pushbutton switch. The recorder pen will drop and the EMA-910 will scan up frequency, band switching as required, until the scan high limit frequency is reached. At the scan high frequency limit the recorder pen will lift, the scan will reverse direction and sweep down frequency at maximum speed, band switching as required, until the scan low frequency limit is reached, thereby completing the single scan cycle.

w. Note the recorder display. After the scan cycle is completed mark the MULTIPLIER switch dB indication beside each recorded maximum deflection.

x. Rotate the MULTIPLIER switch one step counterclockwise and repeat steps v and w. Note that any recorder deflection above the 20 dB mark of the graph paper obtained in step v will now result in an off-scale deflection.

y. Repeat step x until the last scan cycle is performed with the MULTIPLIER switch set to $X10^{0}$ +0 DB.

z. The strength of the intercepted signal components coupled to the RF INPUT connector can be evaluated from the recorded data as being equal to the algebraic sum of the following values:

(1) The amplitude of the recorded deflection (in dB);
(2) The dB indication of the MULTIPLIER switch corresponding to the scan cycle of the data (in dB);
(3) The data normalization curve factor (in dB) at the measurement frequency (see figure 2-9).

Note

For narrowband signals, the applied signal component strength (as evaluated above) is expressed in dB above 1 uV.

For broadband signals, the intercepted signal level (as calculated above) must be reduced by a factor of 14 dB to be expressed above 1 uV/MHz.

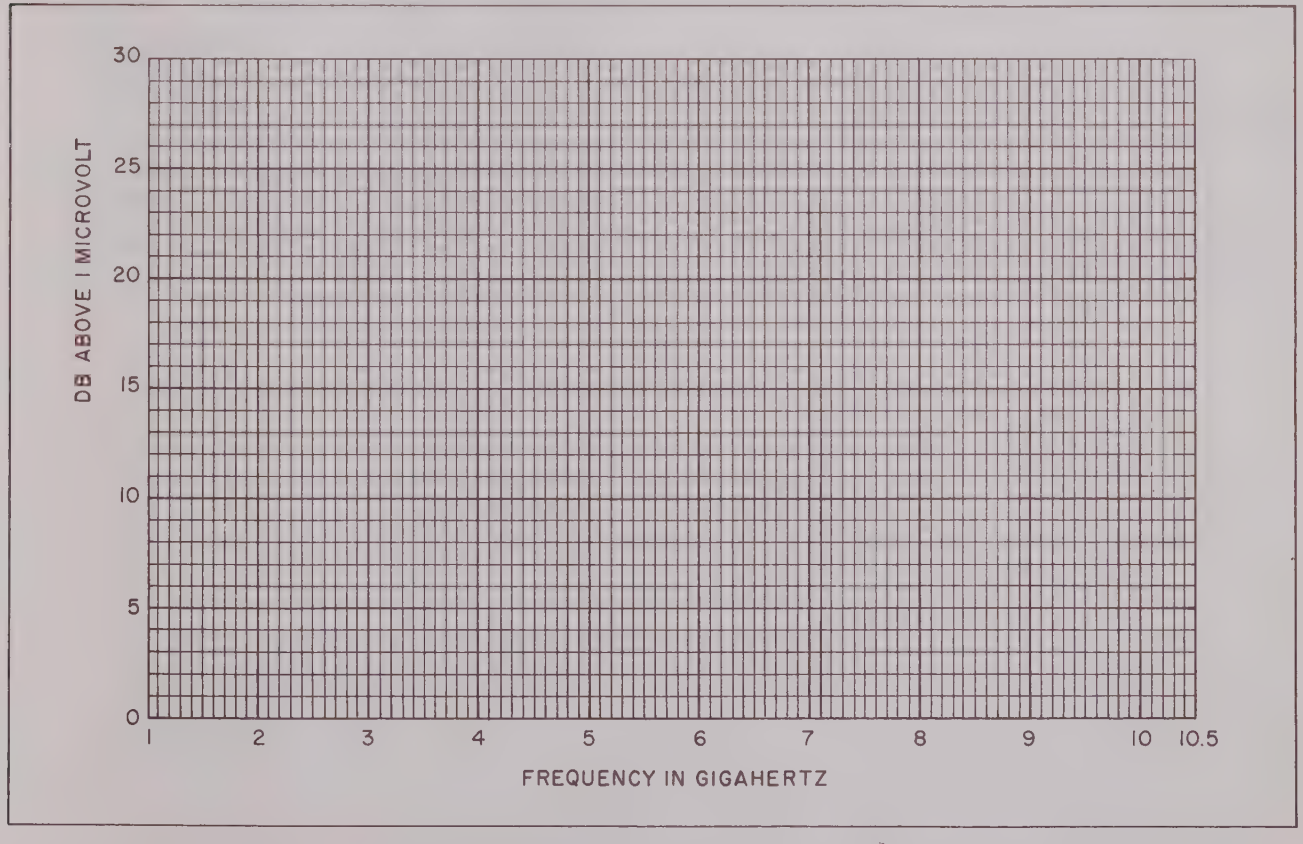


Figure 2-8. Sample Precalibrated Graph Paper for Use in Conjunction with a Standard 8-1/2 x 11 Inch X-Y Recorder

aa. The radiated field strength of a signal component can be determined by algebraically adding the following factors to the intercepted signal component strength determined in step z:

(1) The antenna factor of the receiving antenna (in dB). (See figure 2-6 for the factors of the Models 1010, 1020, 1030 and 1040 Horn Antennas.)

(2) The attenuation of the cable coupling the antenna output to the RF INPUT connector (in dB). (See figure 2-5 for the attenuation characteristics of the EMC 910-160 six-foot r-f cable.) Note that the resulting field strength values are expressed in dB above 1 uV/meter for narrowband signals and dB above 1 uV/MHz/meter for broadband signals.

2-21. AUTOMATIC SIGNAL SURVEILLANCE. To program the EMA-910 for automatic surveillance of the signal content within a specified frequency sector, proceed as directed in steps a through r of paragraph 2-20 and then continue as described below.

a. Set the SWEEP MODE switch to SECTOR.

b. Couple the signal to be monitored to the RF INPUT connector.

c. Momentarily depress the SWEEP START pushbutton switch. The recorder pen will drop and the EMA-910 will scan up frequency, band switching as required, until the upper frequency limit of the sector is reached. At the sector high frequency limit the scan will reverse direction and sweep down frequency, band switching as required, until the sector low frequency limit is reached. This cycle will continue, without the necessity of depressing the SWEEP START pushbutton switch, as long as the SWEEP MODE switch is kept in SECTOR. Note that the direction of the scan can be reversed at any point by depressing the SWEEP REVERSE pushbutton switch.

d. Set the MULTIPLIER switch to that position which provides an optimum indication of the signal content under surveillance.

2-22. PACKAGING INSTRUCTIONS.

2-23. SHORT TERM STORAGE. If the equipment is to be stored for a short time, protect the EMA-910 by covering it with a sheet of plastic or paper. Protect all supplied and optional accessories, as well as the instruction manual, by appropriate means. Store the equipment in a clean and dry area that is not subject to extremes in environmental conditions.

2-24. LONG TERM STORAGE OR SHIPMENT. If the equipment is to be stored for a long period of time, or shipped, proceed as directed in either step a, b, or c.

a. If the original wrappings and cartons have been preserved, package the equipment as illustrated in figure 2-10.

b. If transit cases are available, place each item in its appropriate case.

c. If new packing material is to be employed, first wrap the Data Evaluation Unit in a moisture-proof barrier and then seal. Wrap and seal the Frequency Selection Unit in a similar manner. Wrap and seal all accessories. Place the Data Evaluation Unit and Frequency Selection Unit in individual boxes or cartons, filling empty spaces with the accessories. Add suitable filler material to prevent possible shifting of the components during transit. Seal and mark each box and/or carton. Should conditions warrant rugged packaging, enclose each box and/or carton in an outer wooden crate or metal transit chest.

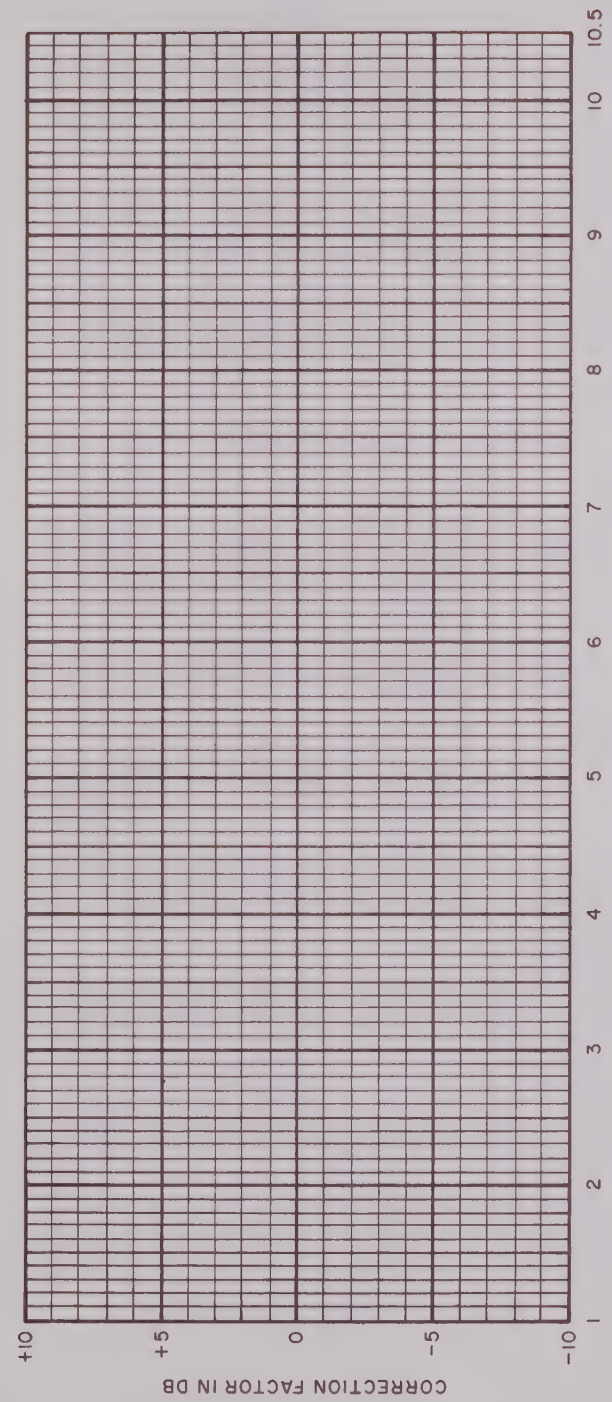


Figure 2-9. Normalization Curve

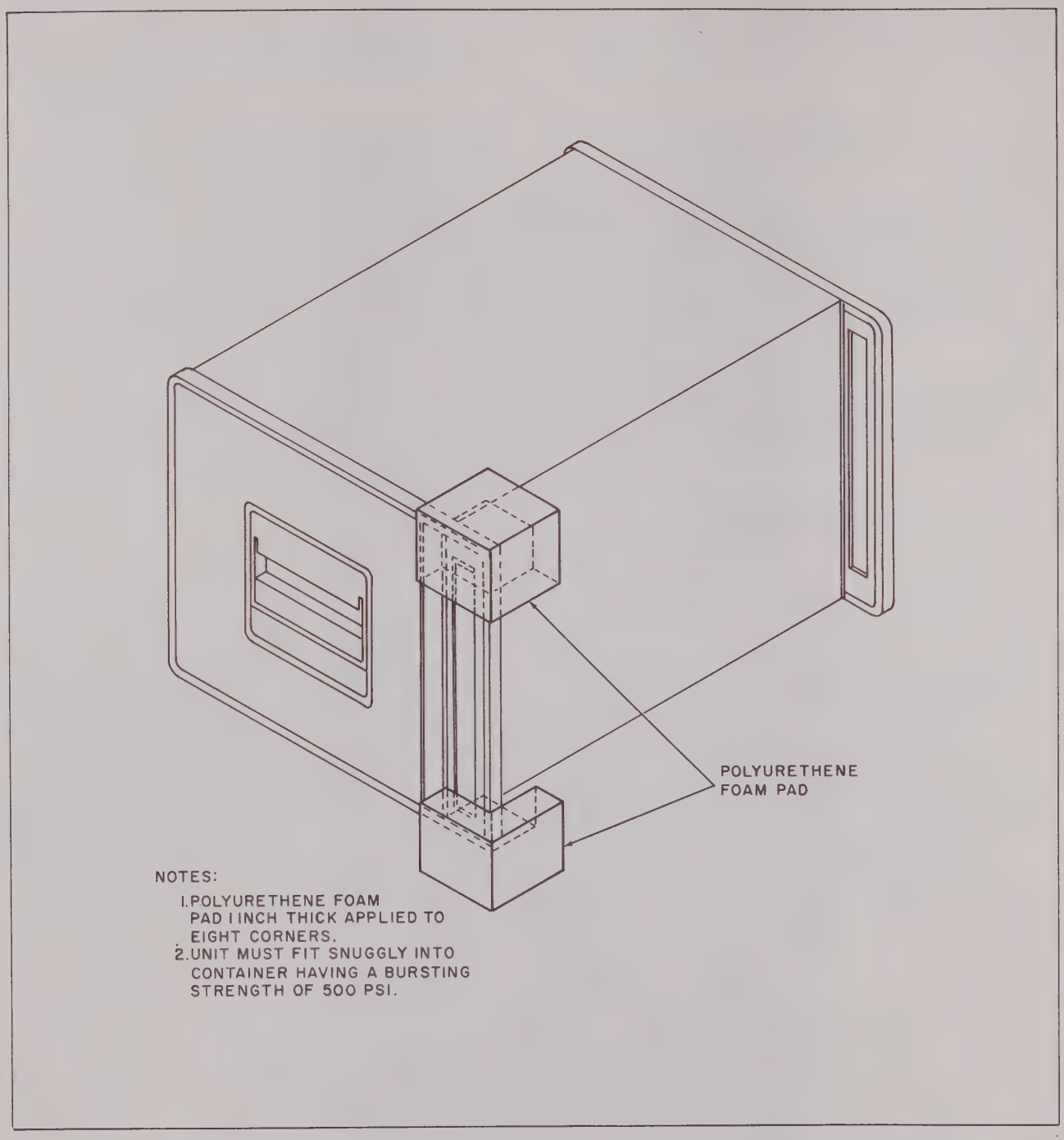

POLYURETHENE
FOAM PAD
NOTES:
1. POLYURETHENE FOAM PAD 1 INCH THICK APPLIED TO EIGHT CORNERS.
2. UNIT MUST FIT SNUGGLY INTO CONTAINER HAVING A BURSTING STRENGTH OF 500 PSI.

Figure 2-10. Packaging Diagram

Company: _____ Technician: _____

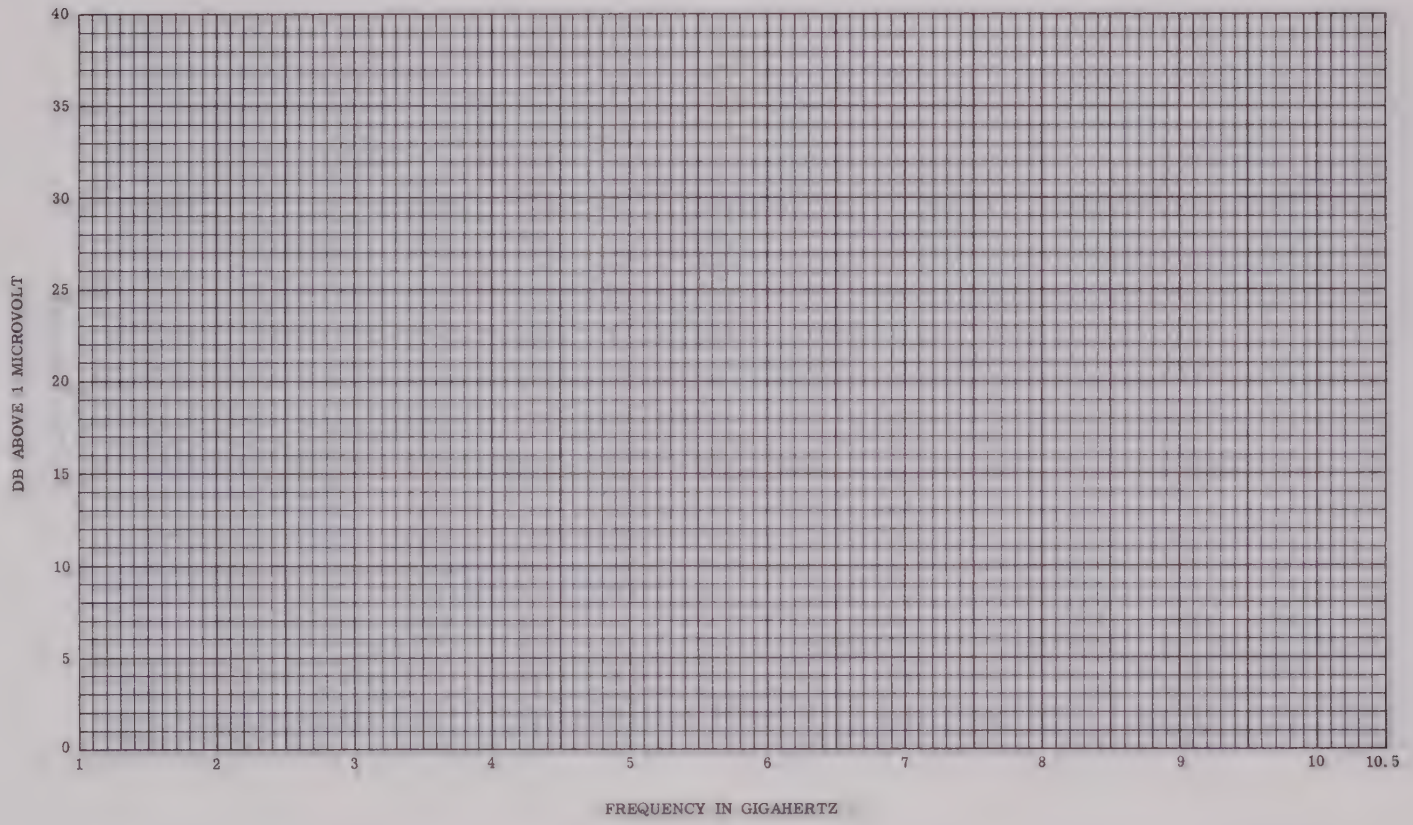
Test Specimen: _____ Date: _____

Type of Interference: _____ Test Specification: _____

Analysis Mode: _____ I-f Bandwidth: _____

Receiver: EMA-910, Serial No. _____ Receiver Calibration Date: _____

Scan Rate: _____ Test Site: _____



Test Specimen: _____

Type of Interference: _____

Analysis Mode: _____

Receiver: EMA-910, Serial No. _____

Scan Rate: _____

Date: _____

Test Specification: _____

1-f Bandwidth: _____

Receiver Calibration Due: _____

DE ABOVE 1 MICROVOLT

STRONG IN SIGNAL

Company: _____ Technician: _____

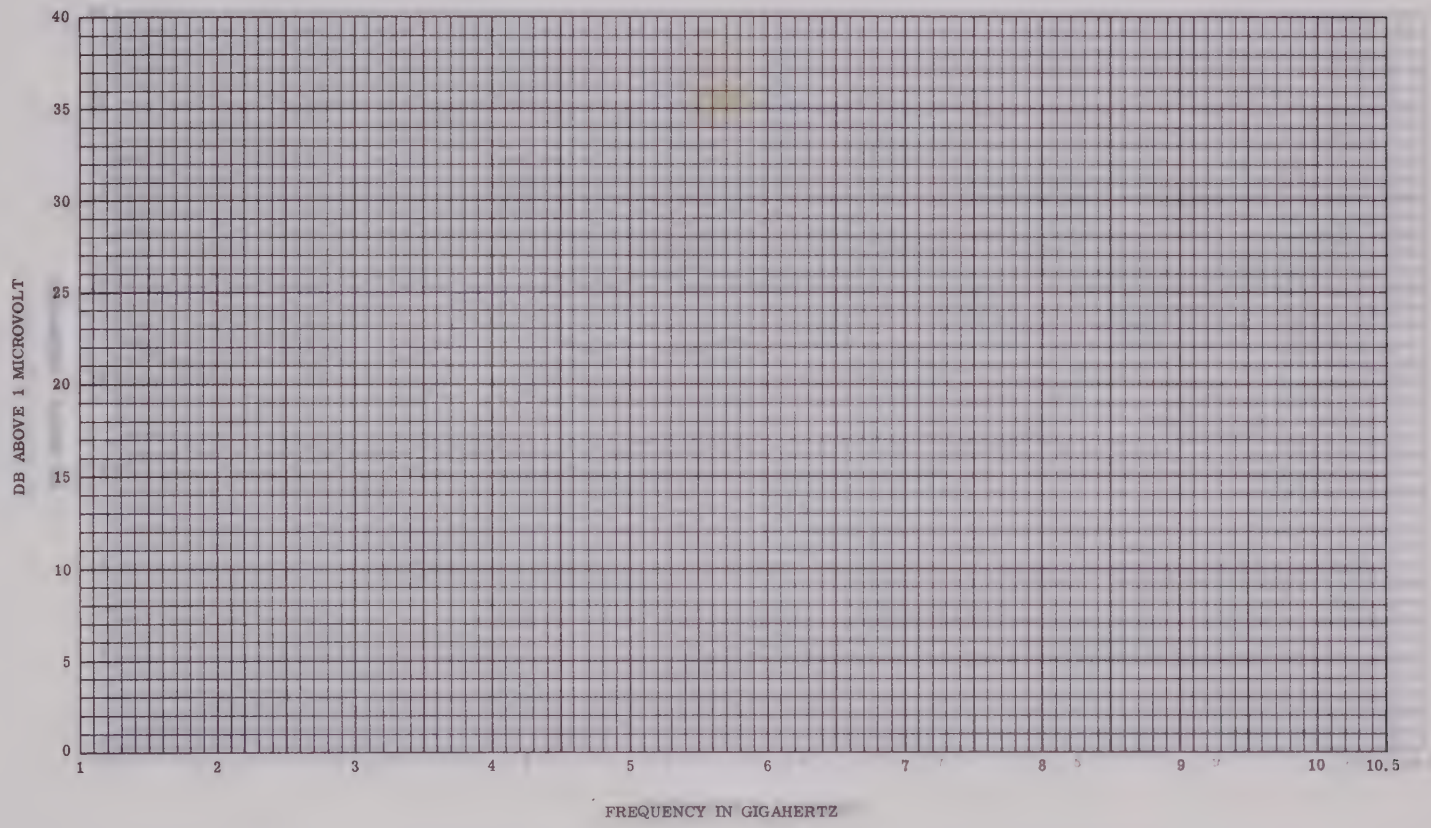
Test Specimen: _____ Date: _____

Type of Interference: _____ Test Specification: _____

Analysis Mode: _____ I-f Bandwidth: _____

Receiver: EMA-910, Serial No. _____ Receiver Calibration Date: _____

Scan Rate: _____ Test Site: _____



Technician: _____

Date: _____

Test Specification: _____

1-f Bandwidth: _____

Receiver Calibration Date: _____

Test Site: _____

Test Specimen: _____

Type of Interference: _____

Analysis Mode: _____

Receiver: EMA-910, Serial No. _____

Scan Rate: _____

FREQUENCY IN GIGAHERTZ

Company: _____ Technician: _____

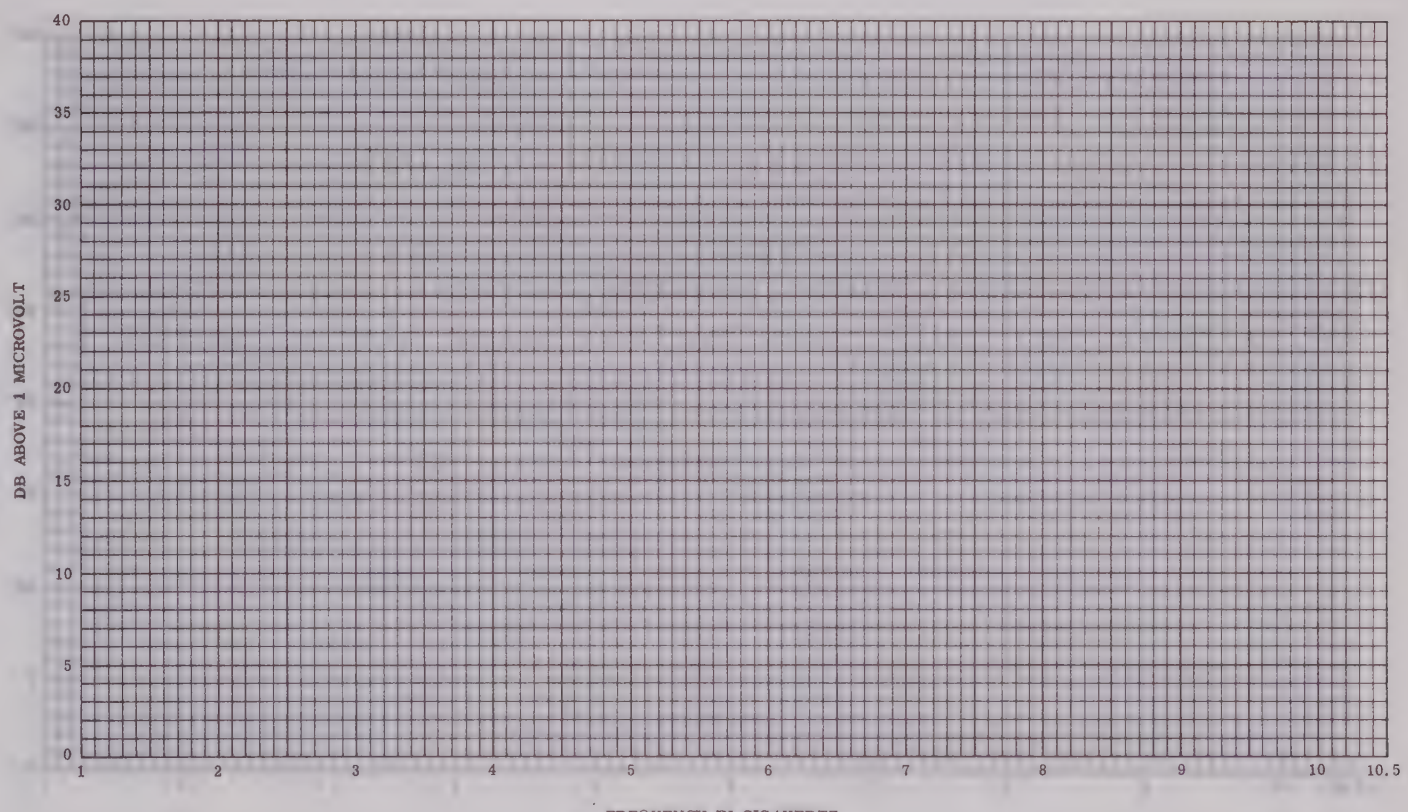
Test Specimen: _____ Date: _____

Type of Interference: _____ Test Specification: _____

Analysis Mode: _____ I-f Bandwidth: _____

Receiver: EMA-910, Serial No. _____ Receiver Calibration Date: _____

Scan Rate: _____ Test Site: _____



Technician: _____

Test Specification: _____

I-f Bandwidth: _____

Test Site: _____

Test Specimen: _____

Type of Interference: _____

Analysis Mode: _____

Scan Rate: _____

Receiver: EMA-310, Serial No. _____

Receiver Calibration Date: _____

TRANSMISSION LOSS, 1 WATT dB

FREQUENCY IN MEGAHERTZ

Company: _____ Technician: _____

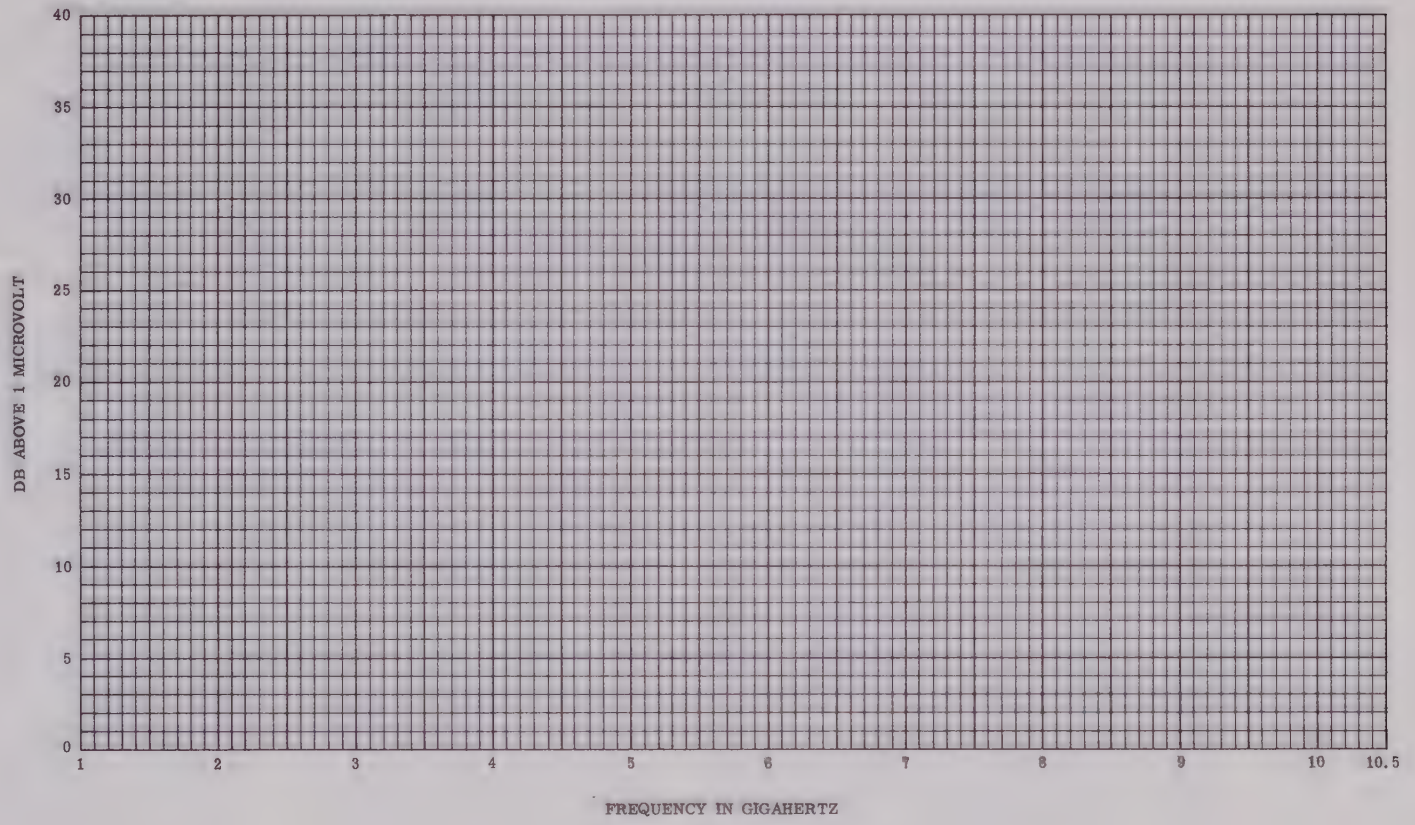
Test Specimen: _____ Date: _____

Type of Interference: _____ Test Specification: _____

Analysis Mode: _____ I-f Bandwidth: _____

Receiver: EMA-910, Serial No. _____ Receiver Calibration Date: _____

Scan Rate: _____ Test Site: _____



Company: _____ Technician: _____

Test Specimen: _____ Date: _____

Type of Interference: _____ Test Specification: _____

Analysis Mode: _____ I-f Bandwidth: _____

Receiver: EMA-910, Serial No. _____ Receiver Calibration Date: _____

Scan Rate: _____ Test Site: _____

ELECTROMAGNETIC COMPATIBILITY

Company: _____ Technician: _____

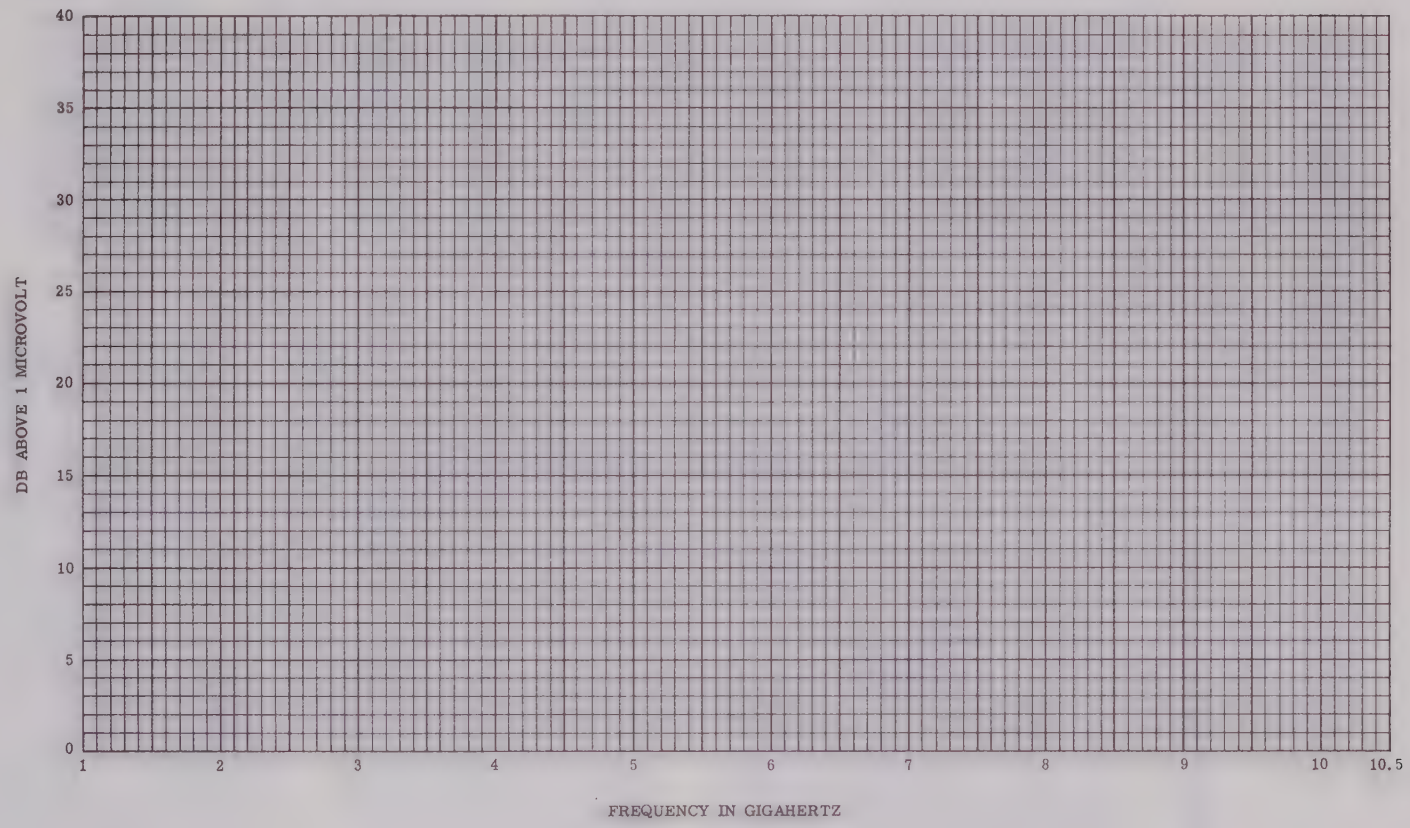
Test Specimen: _____ Date: _____

Type of Interference: _____ Test Specification: _____

Analysis Mode: _____ I-f Bandwidth: _____

Receiver: EMA-910, Serial No. _____ Receiver Calibration Date: _____

Scan Rate: _____ Test Site: _____



Company: _____

Test Specimen: _____

Type of Interference: _____

Analysis Mode: _____

Receiver: EMA-910, Serial No. _____

Scan Rate: _____

Test Site: _____

Technician: _____

Date: _____

Test Specification: _____

1-t Bandwidth: _____

Receiver Calibration Date: _____

Company: _____ Technician: _____

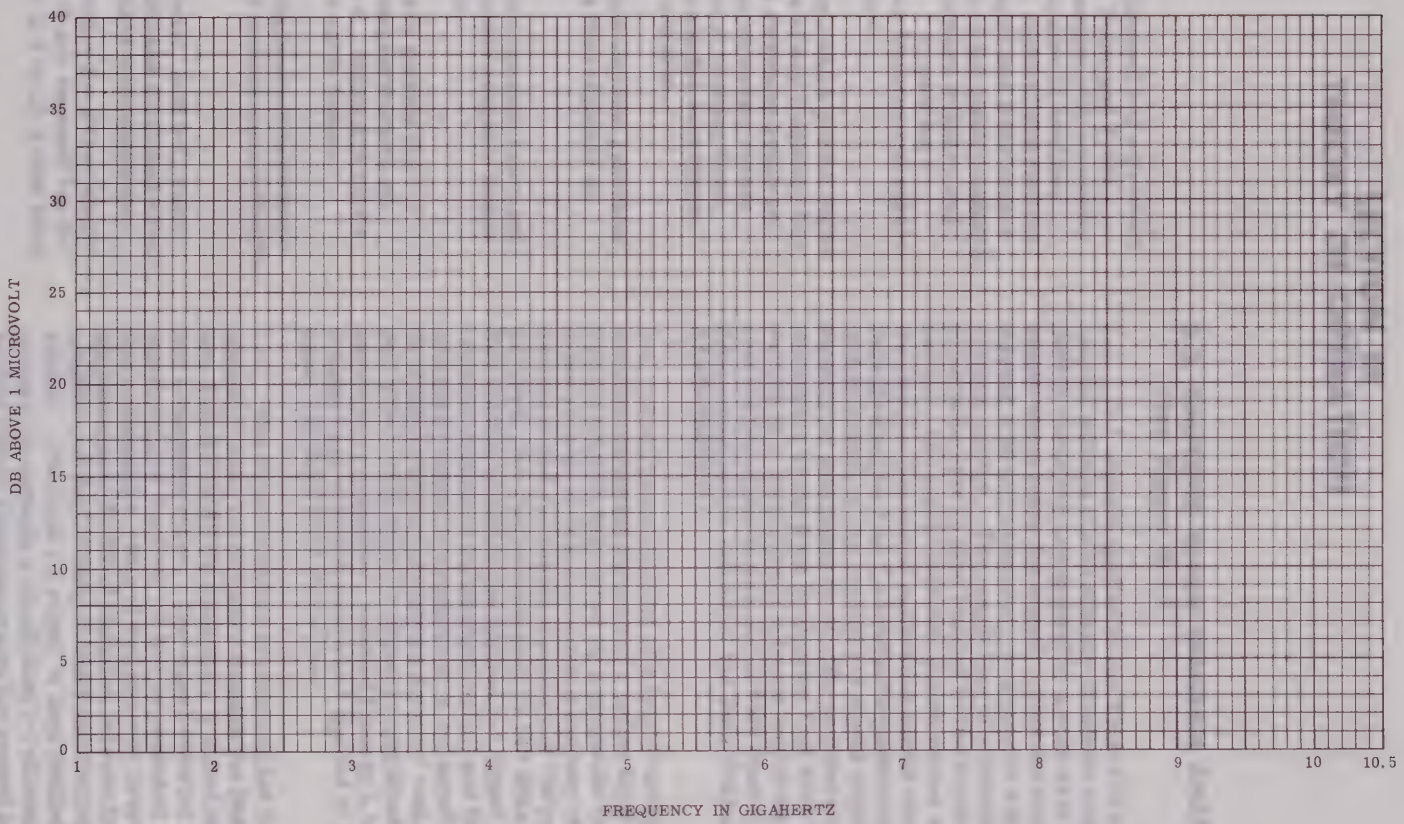
Test Specimen: _____ Date: _____

Type of Interference: _____ Test Specification: _____

Analysis Mode: _____ I-f Bandwidth: _____

Receiver: EMA-910, Serial No. _____ Receiver Calibration Date: _____

Scan Rate: _____ Test Site: _____



Company: _____

Test Specimen: _____

Type of Interference: _____

Analysis Mode: _____

Receiver: EMA-810, Serial No. _____

Scan Rate: _____

Technician: _____

Date: _____

Test Specification: _____

I-F Bandwidth: _____

Preselector Calibration Date: _____

Test Site: _____

SECTION III
THEORY OF OPERATION

3-1. GENERAL.

3-2. The EMA-910 is a sophisticated and extremely sensitive calibrated microwave Noise and Field Intensity Meter which, in conjunction with accessory calibrated antennas, enables the user to evaluate absolute magnitude, frequency, spectral distribution and modulation content of r-f fields and interference within the 1.0 to 10.5 GHz band of the electromagnetic spectrum in accordance with standard military and commercial RFI specifications. In addition to conventional microwave receiver features and capabilities, the EMA-910 incorporates:

a. Four self-contained tuners which permit rapid measurement of signals present at any frequency between 1.0 and 10.5 GHz. Band switching requires only the changing of a single switch setting rather than the time-consuming method of shutting down, physically interchanging tuners and the subsequent equipment re-energization and warmup.

b. A self-contained broadband impulse generator for calibrating the equipment at the frequency of operation.

c. Triple-cavity preselectors for each tuner and a high-frequency first i-f to provide adequate image and spurious response rejection.

d. The capability of physically placing the r-f section of the equipment in close proximity to inaccessibly-located antennas (i.e., shipboard masts and tower tops) to minimize r-f cable losses.

e. Both electronic and mechanical afc (automatic frequency control) to lock on to applied signals despite frequency drift.

f. Both high-frequency (pre i-f, post i-f, video and fm) and low-frequency (audio and stretched video) outputs for application to auxiliary test equipment.

g. Automatic scanning circuitry for either single or continuous sector scanning of any segment (up to the full frequency range) of the 1.0 to 10.5 GHz band. Band switching is automatic.

h. Analog x (frequency) and Y (amplitude) outputs for permanent recording of measurement data.

i. Selectable i-f bandwidths to permit evaluation of signal spectral distribution.

j. A rear panel multipin connector for coupling of remote readout and/or control equipment.

3-3. SIMPLIFIED BLOCK DIAGRAM ANALYSIS. (See Figure 3-1.)

3-4. R-f signals applied to the EMA-910 are coupled through the Frequency Selection Unit RF INPUT connector and applied to a coaxial transfer switch which feeds the signal, either directly or through a 40-dB attenuator, to a coaxial signal selector switch. The output line of a broadband impulse generator is also coupled to the signal selector switch. The signal selector switch routes either the impulse generator calibration signal (when the Data Evaluation Unit CALIBRATE pushbutton switch is depressed) or the applied r-f signal (either directly or attenuated by 40-dB, as determined by the setting of the Data Evaluation Unit MULTIPLIER switch) to a coaxial band selector switch which couples the signal to any one of four tuners, as determined by the setting of the Data Evaluation Unit BAND SWITCH.

3-5. Each tuner consists of a triple-cavity preselector (bandpass filter) and a reflex klystron first local oscillator, both tuned by a precision mechanical drive system so that the output frequency of the local oscillator and the center frequency of the preselector passband are always separated by 240 MHz. Both that portion of either the applied r-f signal (or the impulse generator calibration signal) and the local oscillator output are coupled to a balanced crystal first mixer which generates a first i-f centered at 240 MHz. This first i-f signal is amplified by a 240-MHz preamplifier, coupled through a second coaxial band selector switch and applied to the rear panel 240 MHZ OUT connector.

3-6. The first i-f signal is then coupled to the remainder of the i-f circuitry through the Data Evaluation Unit 240 MHZ IN connector, a signal sampler and a bandpass filter. The signal sampler permits monitoring of the first i-f line by means of an auxilary panadaptor while simultaneously providing approximately 20 dB of isolation between the panadaptor and the i-f line, thereby minimizing loading effects. The first i-f signal is then coupled, either directly or through a 20-dB step i-f attenuator, to a second mixer which generates the second and final 60-MHz i-f by heterodyning the first i-f signal with the 180-MHz output of a crystal-controlled oscillator.

3-7. The second i-f signal is then routed either directly or through another 20-dB step i-f attenuator to a 60-MHz linear i-f amplifier. The overall gain of the linear amplifier is adjusted by the IF GAIN control during calibration of the system. The output of the linear i-f amplifier is coupled to a 60-MHz logarithmic i-f amplifier through selectable band

limiting filters and a signal sampler. The filters enable the operator to select equipment calibrated impulse bandwidths while the sampler permits monitoring of the band limited second i-f signal on an auxiliary panadaptor. The log i-f amplifier, a sequential detection i-f amplifier producing a video output logarithmically proportional to the input, supplies the signal applied to the peak detector (refer to paragraph 3-8), the video stretch circuitry (refer to paragraph 3-10) and to the VIDEO connector where the amplitude modulation content of the applied r-f signal may be monitored with an oscilloscope. A portion of the i-f signal, taken midway in the sequential detection line, is applied to a 60-MHz i-f amplifier/afc discriminator (refer to paragraph 3-11).

3-8. The peak detector provides a d-c output proportional to the true peak value of the applied signal. Timing circuitry is provided to permit the peak detector to retain its charge for a predetermined interval. The timing circuitry also allows the detector, which continuously samples the video line, to charge up to higher level signal without recycling the holding interval. The presence of a lower level signal, however, triggers the dumping circuitry to discharge the detector and simultaneously initiates a new holding interval during which the detector charges to the new signal level. This capability is of particular importance when the EMA-910 is scanning, as it allows the equipment to respond to a signal of lower amplitude adjacent to a previously intercepted signal.

3-9. The peak detector output is coupled to the front panel meter when the ANALYSIS MODE switch is set to PEAK. When the ANALYSIS MODE switch is set to SLIDEBACK, the peak level of the video signal is compared with an adjustable d-c voltage obtained from the SLIDEBACK THRESHOLD control. Setting the ANALYSIS MODE switch to RMS couples a lowpass filter into the video line. This filter removes the amplitude modulation content from the signal and allows the meter to indicate the rms level of the applied signal.

3-10. The video stretch circuitry provides three degrees of stretching to permit monitoring of narrow pulses on an auxiliary oscilloscope. The audio modulation present on the applied signal is coupled to an audio amplifier which drives both the PHONES and SPEAKER receptacles.

3-11. Frequency drift of either the applied r-f signal or the reflex klystron local oscillator will result in a corresponding drift in the i-f signal. The 60-MHz i-f amplifier/afc discriminator senses this shift and produces a d-c output proportional to the deviation from the desired i-f center frequency. This d-c voltage is processed and applied to the klystron repeller and/or servomotor (when the SWEEP MODE switch is set to SECTOR, the AFC switch is set to ON and the SIGNAL THRESHOLD control is adjusted to cause the SIGNAL PRESENT indicator lamp to illuminate) to keep the EMA-910 tuned to the applied signal during manual or sector scan operation. The discriminator also recovers the frequency modulation content of the applied signal and couples it to the FM connector.

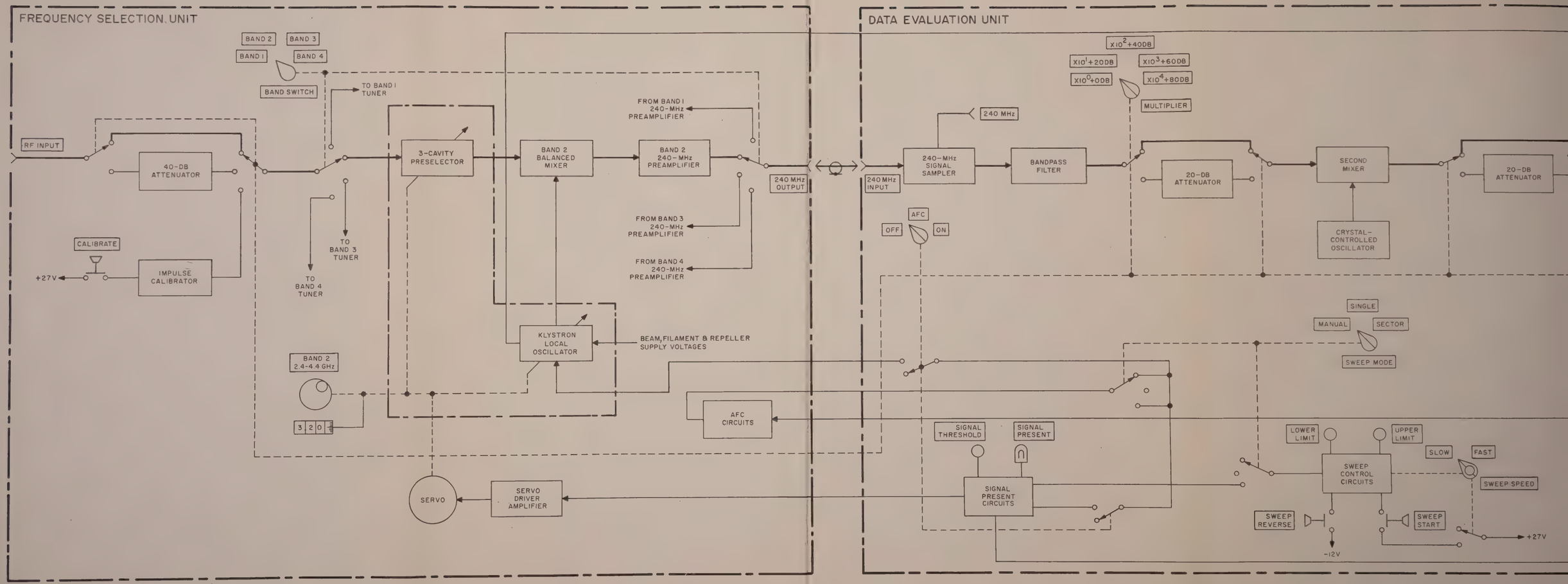
3-12. DETAILED CIRCUIT ANALYSIS, R-F SECTION. (See Figure 3-2.)

3-13. INPUT SIGNAL ROUTING. R-f signals under analysis are coupled through RF INPUT connector J105 and applied to transfer switch Z101. When MULTIPLIER switch S203 is set to $X10^0$ +0 DB, $X10^1$ +20 DB or $X10^2$ +40 DB (and CALIBRATE pushbutton switch S213 is not depressed), both input attenuation control relay K106 and signal selector control relay K107 are unenergized. The normally-closed contacts of K106 (9-1, 10-2 and 11-3 in parallel) place both the coil of Z101K1 and stepping motor S102B1 (the latter via TS102-D) across the unregulated +25 and -7 volt supplies. Energization of both Z101K1 and the stepping motor couple the applied r-f signal directly to tuner selector switch Z102 (refer to paragraph 3-18).

3-14. When the MULTIPLIER switch is set to either $X10^3$ +60 DB or $X10^4$ +80 DB (and the CALIBRATE pushbutton switch is not depressed), +27 volts is impressed across the coil of K107 and, through steering diode CR130, across the coil of K106. The closure of contacts 9-5, 10-6 and 11-7 of K106, in series with closed contacts 9-5, 10-6 and 11-7 of K107, couple both the coil of Z101K2 and stepping motor S102B1 (the latter via TS102-C) across the unregulated +25 and -7 volt supplies, thereby routing the applied r-f signal to tuner selector switch Z102 through 40-dB attenuator AT101.

3-15. CALIBRATION SIGNAL ROUTING. Depression of CALIBRATE pushbutton switch S213 simultaneously couples +27 volts across the coils of calibration control relays K202 and K203 and, through steering diode CR133, across the coil of K106. Energization of K202 causes contacts 10-2 to open, breaking the +27 volt line to the coil of K107. K107 is maintained de-energized by the polarity of steering diode CR130. Since only K106 is energized, stepping motor S102B1 is coupled (via TS102-B) across the unregulated +25 and -7 volt lines, thereby coupling the output of impulse generator Z104 (refer to paragraph 3-16) to S102. Note that, since K106 is energized while K107 is not, the applied r-f signal is open-circuited and cannot be coupled to the tuners. Releasing the CALIBRATE pushbutton switch recouples the applied r-f signal (either directly or through the 40-dB attenuator, as determined by the setting of the MULTIPLIER switch) to Z102.

3-16. IMPULSE GENERATOR Z104. Impulse generator Z104 is an open-ended charged line that is discharged at a 65-Hz rate (refer to paragraph 3-17) into a 50-ohm line (AT102) to produce a train of extremely narrow pulses. The repetition rate and width of these narrow pulses results in the generation of a broadband signal having frequency components every 65 Hz across the entire 1 to 10.5 GHz band. The charging voltage applied to the open-ended line is obtained from the +12 volt supply through the voltage divider consisting of R155 and R156 (when the BAND SWITCH is set to BAND 1, BAND 2 or BAND 3) or directly from the analog x output voltage (when the BAND SWITCH is set to BAND 4).


FREQUENCY SELECTION UNIT
BAND 2
BAND 3
BAND 1
BAND 4
BAND SWITCH
TO BAND 1 TUNER
RF INPUT
40-DB ATTENUATOR
3-CAVITY PRESELECTOR
BAND 2 BALANCED MIXER
BAND 2 240-MHz PREAMPLIFIER
FROM BAND 1 240-MHz PREAMPLIFIER
240 MHz OUTPUT
FROM BAND 3 240-MHz PREAMPLIFIER
FROM BAND 4 240-MHz PREAMPLIFIER
TO BAND 3 TUNER
TO BAND 4 TUNER
CALIBRATE
+27V
IMPULSE CALIBRATOR
KLYSTRON LOCAL OSCILLATOR
BEAM, FILAMENT & REPELLER SUPPLY VOLTAGES
BAND 2 2.4-4.4 GHz
3 2 0 MHz
AFC CIRCUITS
SERVO
SERVO DRIVER AMPLIFIER
DATA EVALUATION UNIT
X10²+40DB
X10¹+20DB
X10³+60DB
X10⁰+0DB
X10⁴+80DB
MULTIPLIER
240 MHz
240 MHz INPUT
240-MHz SIGNAL SAMPLER
BANDPASS FILTER
20-DB ATTENUATOR
SECOND MIXER
CRYSTAL-CONTROLLED OSCILLATOR
20-DB ATTENUATOR
AFC
OFF
ON
SINGLE
MANUAL
SECTOR
SWEEP MODE
SIGNAL THRESHOLD
SIGNAL PRESENT
SIGNAL PRESENT CIRCUITS
LOWER LIMIT
UPPER LIMIT
SWEEP CONTROL CIRCUITS
SLOW
FAST
SWEEP SPEED
SWEEP REVERSE
SWEEP START
-12V
+27V

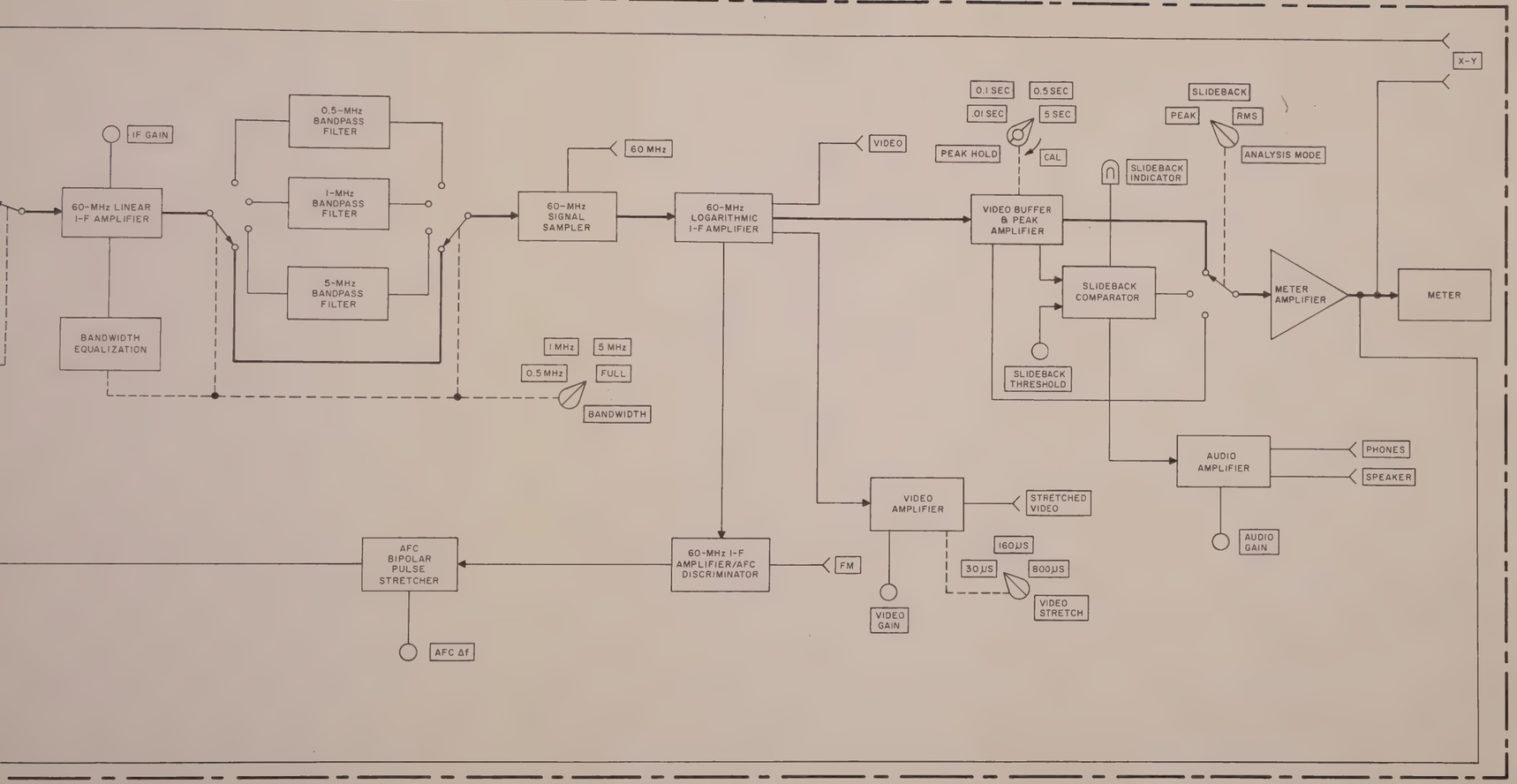


Figure 3-1. Model EMA-910 Noise and Field Intensity Meter, Simplified Block Diagram

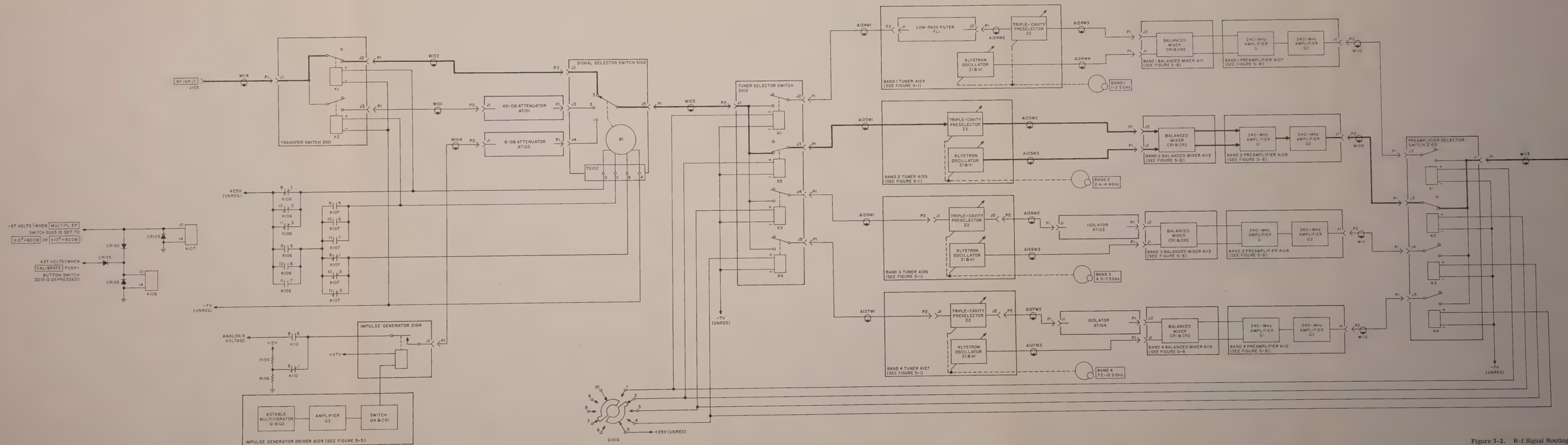


Figure 3-2. R-f Signal Routing Diagram

3-17. IMPULSE GENERATOR DRIVER A104. The voltage required to drive the impulse generator reed relay is obtained from impulse generator driver board A104 (see figure 5-5). When CALIBRATE pushbutton switch S213 is depressed, +12 volts is coupled through closed contacts 12-8 of K106 and normally-closed contacts 4-12 of K107 and applied to the driver. Astable multivibrator Q1 and Q2 generates a 65-Hz square wave which is coupled to the base of emitter follower Q3. Whenever Q2 is conducting, the voltage at the emitter of Q3 is sufficiently positive to cause switch Q4 to operate in its saturation region, thereby effectively placing the collector of Q4 at ground and applying +27 volts across the impulse generator reed relay solenoid. When Q2 switches states and becomes cutoff, both Q3 and Q4 also are cutoff and the reed relay is de-energized. Diode CR1 suppresses the transient generated by the de-energization of the reed relay.

3-18. TUNER SELECTION. The applied r-f signal (either direct or attenuated) or the broadband impulse generator calibration signal present at the output of S102 is coupled to the appropriate tuner via tuner selector switch Z102. Energization of Z102 coils K1, K2, K3 or K4 (depending on the setting of band selector stepping switch S101 - refer to paragraphs 3-27 and 3-33) places the coil between the unregulated +25 and -7 volt lines.

3-19. TUNERS A124, A125, A126 AND A127. The four tuner assemblies are similar in construction and principles of operation. Differences exist, due to the frequency band covered by each tuner, in the type of reflex klystron tube employed, operating voltages, cavity modes, etc. These differences are detailed in table 3-1. The reader should refer to figure 5-1 to note actual tuner circuitry.

3-20. Preselectors. Each preselector consists of three aperture-coupled tunable coaxial cavities which act as an overcoupled bandpass filter at the tuner input. The axial length of the cavity center conductor (hence the preselector resonant frequency) is controlled by an adjustable periphery cam which converts the rotational motion imparted to the drive linkage (via the manual tuning control or by the servo drive motor) to translational motion.

3-21. Local Oscillators. The first local oscillator is a reflex klystron mounted in an external resonant cavity. The cavity is in the form of two cylinders - one inside the other. The reflex klystron tube is installed into the cavity so that its first interaction grid contacts the wall of the outer cylinder and the second grid contacts the wall of the inner cylinder. The length of the cavity is determined by a movable non-contacting short positioned by the mechanical drive linkage.

3-22. Since more than one repeller-to-cathode (repeller) voltage will sustain oscillation at a given cavity length (see figure 3-3), the mode which provides optimum output power across the band is employed. This voltage, which is obtained from a variable voltage divider network tied between the beam and repeller supplies, is tracked with the tuning of the cavity length. Power is extracted from the cavity and applied to the balanced mixer associated with the operative tuner.

3-23. BALANCED MIXERS A111, A112, A113 AND A114. That portion of either the applied r-f signal or the broadband impulse generator calibration signal which falls within the bandpass of the preselector is coupled to one input of a balanced mixer (see figure 5-7). The output of the reflex klystron first local oscillator is simultaneously applied to the other input of the mixer. Since the mixer diodes are non-linear devices, the sum and difference frequencies of the two applied signals are generated. The blanaced configuration suppresses both input signals from appearing at the output while simultaneously cancelling local oscillator noise and providing an optimum noise figure. In order to maintain the lowest possible capacitance at the mixer output, the mixer is physically located beside its associated 240-MHz preamplifier.

3-24. 240-MHZ PREAMPLIFIERS A107, A108, A109 AND A110. The 240-MHz preamplifiers (see figure 5-7) are two-stage synchronously tuned amplifiers which serve to amplify the first i-f signal prior to application to the remainder of the i-f circuitry. The 240-MHz output from each balanced modulator diode are coupled through capacitors C2 and C11 and are applied to the base of Q1, where the signals are algebraically added. The d-c crystal current component of the signals are bypassed to ground through low-pass filter networks (L1, C3 and R1 and L6, C12 and R12). After undergoing two stages of amplification the first i-f signal is routed to preamplifier selector switch Z103 (refer to paragraph 3-25). The overall r-f to i-f conversion gain (balanced mixer plus preamplifier) is approximately 20 dB.

3-25. PREAMPLIFIER SELECTION. The appropriate preamplifier for use with the selected tuner is automatically employed by band selector stepping switch S101. In addition to energizing only the proper preamplifier, S101 also routes the output of the energized preamplifier through preamplifier selector switch Z103 to 240 MHZ OUT connector J155, where it is coupled to the remainder of the i-f circuitry in the Data Evaluation Unit via an i-f patch cable.

3-26. DETAILED CIRCUIT ANALYSIS, TUNING MODES. (See Figure 3-4.)

3-27. MANUAL TUNING MODE. When the operator programs the EMA-910 for manually tuned operation by setting SWEEP MODE switch S205 to MANUAL, pins 4 and 1 of S205A contact to couple +27 volts to the wiper (pin 13) of BAND SWITCH S204. Setting S204 to the position corresponding to the desired tuner routs the +27 volts to wafer H of band selector stepping switch S101. The resulting action of S101 is dependent upon the relationship existing between the settings of the BAND SWITCH and the band selector stepping switch, as follows.

TABLE 3-1. TUNER COMPARISON CHART

Characteristic	Tuner			
	Band 1	Band 2	Band 3	Band 4
Frequency range	1.0 to 2.5 GHz	2.4 to 4.4 GHz	4.3 to 7.3 GHz	7.2 to 10.5 GHz
Klystron local oscillator tuning range	1.24 to 2.74 GHz (240 MHz above incoming signal)	2.16 to 4.16 GHz (240 MHz below incoming signal)	4.54 to 7.54 GHz (240 MHz above incoming signal)	6.96 to 10.26 GHz (240 MHz below incoming signal)
Klystron local oscillator tube type	6BM6	6BL6	5721	2K48
Local oscillator cavity mode	1/4 λ	3/4 λ	3/4 λ	3/4 λ
Beam (cathode) supply voltage	-285 volts	-285 volts	-1100 volts	-1245 volts
Repeller supply voltage	-650 volts	-650 volts	-1610 volts	-1610 volts
Repeller mode	2-3/4	2-3/4	2-3/4	3-3/4
Control grid (to cathode) voltage	0 volts	0 volts	Adjusted for cathode current of 21 ma	0 volts
Beam current	15 ma	26 ma	20 ma	12 ma
Preselector cavity mode	1/4 λ	1/4 λ	1/4 λ	1/4 λ
Preselector bandwidth	20 MHz	20 MHz	45 MHz	55 MHz

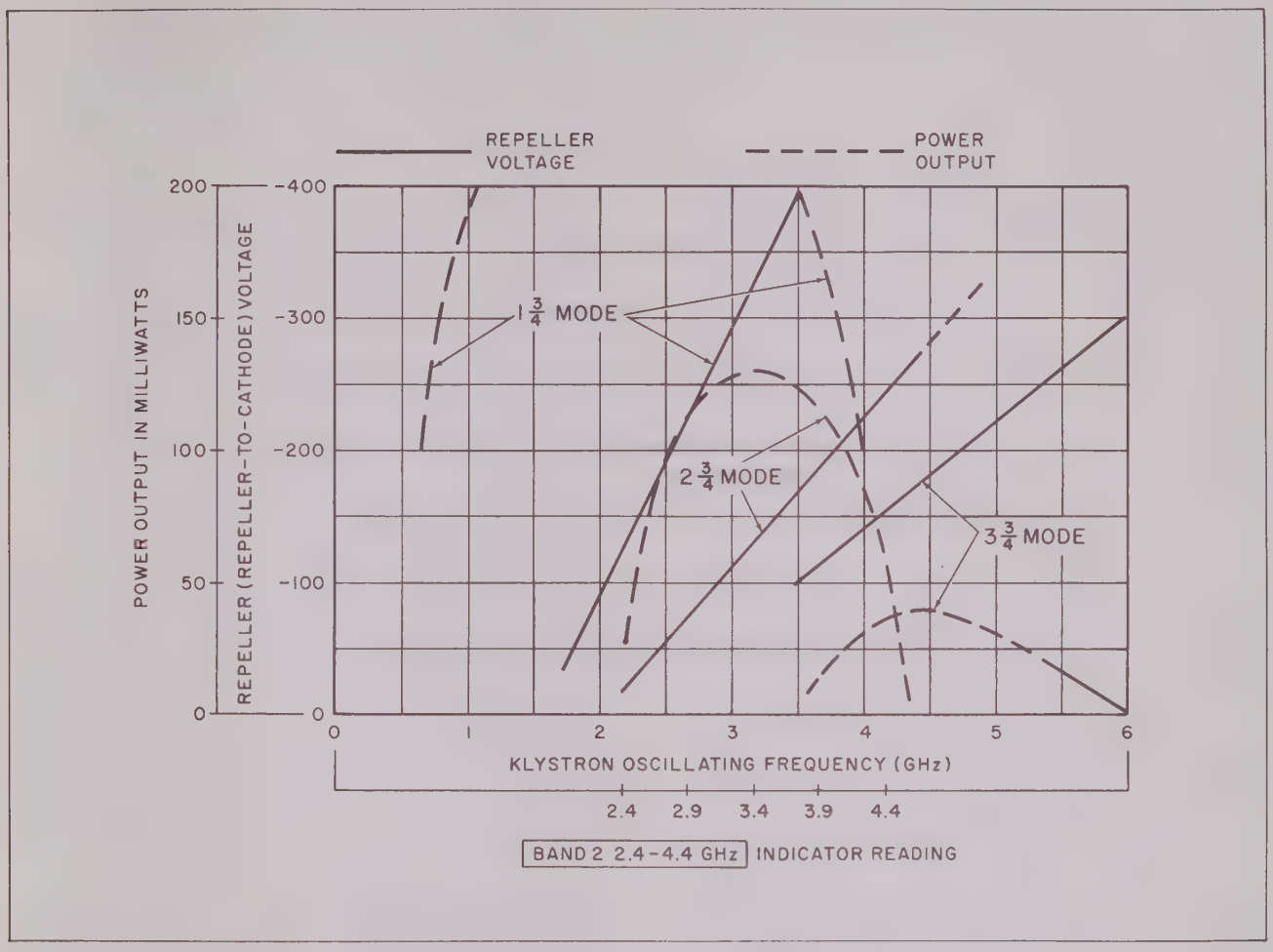


Figure 3-3. Typical Characteristics of Reflex Klystron Local Oscillator A125V1

3-28. When both S101 and S204 are in the positions corresponding to the same tuner (the band 2 tuner as illustrated in figure 3-4), the +27 volts from S204-9 is open-circuited at S101H-2 and cannot be applied to either up-frequency stepping solenoid S101L1A or down-frequency stepping solenoid S101L1B. Since S101 is in the position corresponding to the selected band, the remaining wafers of the switch couple the appropriate operating voltages to the band 2 tuner, route the r-f signal to the band 2 preselector, route the band 2 local oscillator and preselector outputs to the band 2 balanced mixer and couple the output of the band 2 240-MHz preamplifier to the remainder of the equipment i-f circuitry (refer to paragraph 3-70).

3-29. If BAND SWITCH S204 is set for a tuner band (e.g., band 3 or band 4) above the setting of band selector stepping switch S101, the +27 volts is routed through S101H-5 to terminal 13 of up-frequency stepping control relay K105. The other side of the relay coil is tied to the output of clock oscillator A102 (refer to paragraph 3-46). The first transition of the clock oscillator output from +27 volts to ground energizes K105 and a +27 volt pulse causes closure of K105 contacts 9-5, 10-6, 11-7 and 12-8, thereby placing up-frequency stepping solenoid S101L1A across the unregulated +25 and -7 volt supplies. Since the clock oscillator output remains at ground only long enough to permit S101 to step one division to the next higher band (i.e., band 3), the reverse transition from ground to +27 volts will cause K105 to become de-energized. Should +27 volts still be present at S101H-5 (indicating that the BAND SWITCH has been set to BAND 4), this process will be repeated (i.e., S101 will step switch to band 4), at which time +27 volts is no longer coupled to S101H-5 and S101 will cease stepping.

3-30. Conversely, if BAND SWITCH S204 is set for a tuner band (e.g., band 1) below the setting of band selector stepping switch S101, +27 volts is routed to terminal 13 of down-frequency stepping control relay K104 via S101H-10. Since the other side of the relay coil is tied to the output of the clock oscillator, energization of K104 will cause down-frequency stepping solenoid S101L1B to operate and rotate the switch one division to the next lower tuner (i.e., band 1).

3-31. Note that as long as +27 volts appears at either S101H-5 or S101H-10, steering diode CR102 or CR101, respectively, will couple this voltage to pin 6 of memory clear pulse amplifier A209 (refer to paragraph 3-97).

3-32. Once a signal has been intercepted by manual tuning, the operator can activate the electronic afc capability of the EMA-910 to lock onto the signal in spite of small (10 MHz or less) frequency drift. This is accomplished by setting AFC switch S212 to ON. S212 couples +27 volts via normally-closed contacts 10-2 of calibrate control relay K202 and contacts 11 and 14 of S205B across the coil of afc electronic tuning control relay K103, thereby coupling the afc error voltage (refer to paragraph 3-56) to afc bipolar chopper A106 (refer to paragraph 3-59). This electronic tuning capability will keep the EMA-910 tuned to the applied r-f signal (provided that the signal does not drift beyond the afc electronic tuning range) as long as AFC switch S212 is set to ON.

3-33. SEMI AUTOMATIC SINGLE SECTOR SCAN MODE. When the operator programs the EMA-910 for semi-automatic single sector scan operation as directed in paragraph 2-20 by adjusting both LOWER LIMIT control R234 and UPPER LIMIT control R236 for the desired scan low and high frequency limits, respectively, after first rotating all four tuning controls fully counterclockwise (each tuner set to the low end of its range) and after the BAND SWITCH has been set for the appropriate band, the scan low limit analog voltage applied to pin 14 of low frequency analog voltage comparator A215 (refer to paragraph 3-47) will equal or exceed the analog x voltage from the selected tuner. This causes the output of A215 to switch from +24 volts to ground, producing a negative-going step voltage which places scan direction control flip-flop A212 (refer to paragraph 3-49) in the "set" state (i.e., +24 volt output). Since the voltage across the coil of scan direction control relay K101 is not sufficient to energize the relay, normally-closed contacts 10-2 couple +24 volts to the wiper (pin 9) of SWEEP MODE switch S205B and, through dropping resistor R229, to SWEEP RATE control R230.

3-34. When the operator places the SWEEP MODE switch to SINGLE, +27 volts is coupled through closed contacts 4 and 2 of S205A and applied simultaneously across the coil of single scan control relay K206 and, through steering diode CR217 and normally-closed contacts 9-1 of K101, to the movable contact of the band 1, band 2 and band 3 high limit switches (A124S2, A125S2 and A126S2, respectively). Momentary depression of SWEEP START pushbutton switch S209 (when SWEEP RATE switch S211B is rotated clockwise from its OFF position) couples +27 volts across the coil of sweep start inhibit control relay K211 (through steering diode A233CR3), across the coil of single scan up-frequency control relay K204 (through steering diode A233CR2 and closed contacts 9-5 of K206) and directly to pin 7 of memory clear pulse amplifier A209 (refer to paragraph 3-97).

3-35. Energization of K204 causes contacts 9-5 to close and apply +24 volts (from K101-10 via contacts 9 and 7 of S205A) through steering diode CR205 to hold K204 energized after the SWEEP START pushbutton switch has been released. When K204 becomes energized, contacts 10-6 close and apply -24 volts across the coil of single scan bidirectional control relay K207.

3-36. With relays K204, K206 and K207 energized, the positive voltage at the wiper of SWEEP RATE control R230 is coupled through closed contacts 8-12 of K206, 7-11 of K207, closed contacts 4-12 of both K212 and K209 and terminals 7 and 9 of S205A to servo bipolar chopper/preamplifier A103 (refer to paragraph 3-60). The output of A103 is amplified by driver amplifiers Q101 and Q102, causing servomotor A121B1 to rotate in that direction which drives the tuner up in frequency. The driving torque of the servomotor is transmitted to the appropriate tuner through either high-speed clutch A121MP3L1A (when SWEEP RATE switch S211A is set to FAST) or low-speed clutch A121MP3L1B (when S211A is set to SLOW) and band clutch A121MP1L1A, A121MP1L1B, A121MP2L1A or A121MP2L1B. Note that, should the operator inadvertently set the UPPER LIMIT control for a scan high frequency limit below the selected scan low frequency limit, crossover voltage comparator A214 will switch state and crossover control relay K209 will become energized. This will cause contacts 4-12 to open, thereby preventing the servo speed control voltage from R230 from being applied to A103. The scanning mechanism will remain inoperative until the operator properly sets the scan upper and lower frequency limits.

3-37. The tuner that contains the scan low frequency limit will commence scanning up in frequency until one of two possible events occur; either the band high limit is reached or the scan high frequency limit is reached. Should the former occur first, tuner cam-actuated high limit switch S2 will close and couple +27 volts through S101B and S101E to S101H, causing the band selector stepping switch to step one division to the next higher tuner. The scan will continue, after band switching has been completed, until either the band high limit is reached or the scan high frequency limit is reached. When the scan high frequency limit is attained, the tuner x analog voltage equals the voltage appearing at the wiper of UPPER LIMIT control R236, causing the output of high frequency analog voltage comparator A216 to switch from +24v to ground. The negative going step voltage thus generated is simultaneously coupled through steering diode A236CR12 to pin 14 of scan direction control flip-flop A212, placing it in the "reset" state and, through differentiator A236C15 and A236R21, to pin 13 of memory clear pulse amplifier A209 (refer to paragraph 3-97). Transition of A212 from the "set" to "reset" state places its output at ground instead of +24 volts, thereby energizing scan direction control relay K101.

3-38. Energization of K101 couples -24 volts through closed contacts 10-6 to SWEEP RATE control R230 (through dropping resistor R229) and, through contacts 9 and 7 of S205B, steering diode CR212 and closed contacts 9-5 of K207 to the coil of K207. The polarity of CR205 prevents the -24v from being impressed

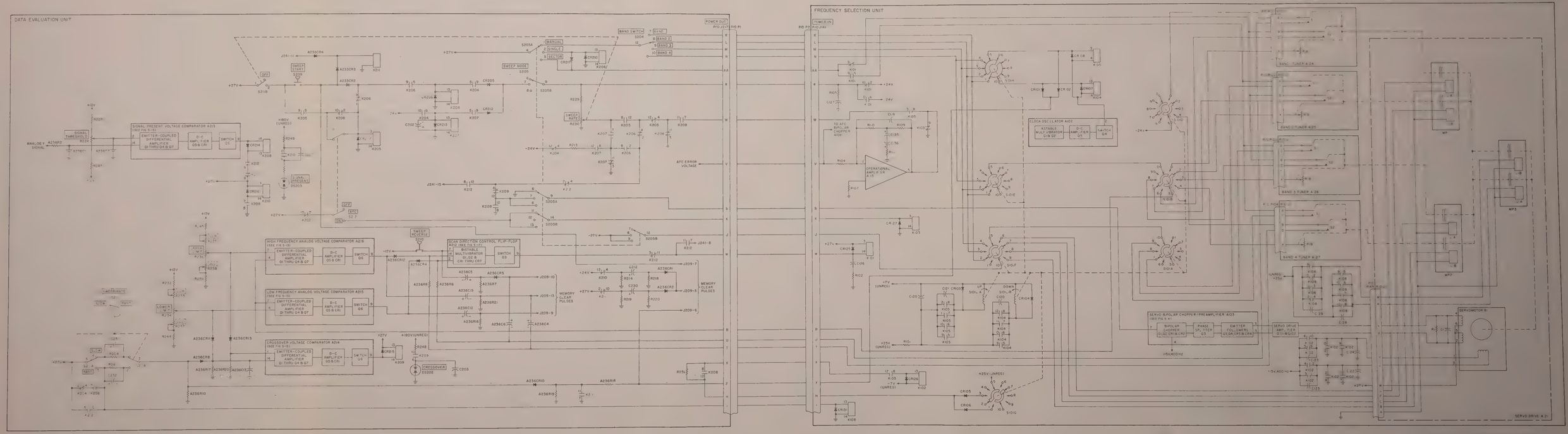


Figure 3-4. Scan Control Circuitry, Composite Schematic Diagram

across the coil of K204, hence the relay becomes de-energized. The polarity of CR212, however, maintains K207 energized. Note that C202 maintains K207 energized during band switching. Since K204 is now de-energized, its normally-closed contacts 10-2 couple -24 volts through dropping resistor R213, contacts 12-8 of K207 and contacts 8-12 of K206 to servo bipolar chopper/preamplifier A103, causing the servomotor to reverse its direction of rotation and proceed, at maximum speed, down frequency. Closed contacts 7-11 of K206 and normally-closed contacts 12-4 of K204 couples +27 volts to the coil of high-speed clutch control relay K108, thereby inserting the high-speed clutch into the transmission path to ensure that the tuner reaches the scan low frequency limit in the shortest period of time.

3-39. When scan direction control flip-flop A212 is in its "reset" state, +27 volts is coupled to the movable contact of the band 2, band 3 and band 4 low limit switches (A125S1, A126S1 and A127S1, respectively). The tuner that contains the high frequency limit will commence scanning down in frequency until either the band low limit is reached or the scan low frequency limit is reached. Should the former occur first, the cam-actuated switch will couple +27 volts to S101H-10, causing the band selector stepping switch to step one division to the next lower tuning band until either the band low limit is reached or the scan low frequency limit is reached. When the scan low limit frequency is reached, the tuner x analog voltage equals the voltage present at the wiper of LOWER LIMIT control R234, causing the output of low frequency analog voltage comparator A215 to switch from +24 volts to ground, generating a negative-going step voltage which is simultaneously applied to pin 14 of scan direction control flip-flop A212 to place it once again in the "set" state and, through differentiator A236C12 and A236R16, to pin 9 of memory clear pulse amplifier A209. The transition of A212 to the "set" state de-energizes K101, coupling +24 volts through normally-closed contacts 10-2 to steering diode CR212. The polarity of the diode, however, prevents the +24 volts from maintaining K207 energized, and the relay drops out. This completes one single scan cycle. Another scan cycle can be initiated by once again depressing the SWEEP START pushbutton switch.

3-40. Note that depression of SWEEP REVERSE pushbutton switch S210 (while the tuner is scanning up in frequency) will toggle A212 into its "reset" state and cause the scan to reverse direction and proceed down frequency at maximum speed. A second depression of the switch, or first depressing the switch when the tuner is scanning down in frequency, will toggle A212 into its "set" state and cause K207 to drop out before the scan low frequency limit is attained. It should be remebered that the operation of the SWEEP REVERSE pushbutton switch will produce the same result that the reaching of the scan frequency limit produces. The single scan cycle can be initiated by again momentarily depressing the SWEEP START pushbutton switch.

3-41. AUTOMATIC CONTINUOUS SECTOR SCAN MODE. When the operator programs the EMA-910 for automatic continuous sector scan operation as directed in paragraph 2-21, the same events take place as described in paragraph 3-33. Setting the SWEEP MODE switch to SECTOR couples +27 volts through closed contacts 4 and 3 of S205A to the movable contacts of the band 1, band 2 and band 3 high limit switches. Note that steering diode CR217 prevents energization of single scan control relay K206 when the SWEEP MODE switch is set to SECTOR.

3-42. Momentary depression of SWEEP START pushbutton switch S209 (when SWEEP RATE switch S211B is rotated clockwise from its OFF position) couples +27 volts across the coil of sweep start inhibit control relay K211 (through steering diode A233CR3), to pin 7 of memory clear pulse amplifier A209 and, through steering diode A233CR2 and normally-closed contacts 9-1 of K206, across the coil of continuous scan control relay K205. Closure of contacts 9-5 of K205 maintains the relay in an energized state (independent of the setting of AFC switch S212) after the SWEEP START pushbutton switch has been released. Normally-closed contacts 10-2 of K101 couple +24 volts to SWEEP RATE control R230 via dropping resistor R229. The positive voltage at the wiper of R230 is coupled through closed contacts 8-12 of K205, normally-closed contacts 4-12 of K206, K212 and K209 and terminals 8 and 9 of S205A to the servo bipolar chopper and preamplifier, causing the tuner to scan up frequency at the selected sweep rate.

3-43. The up-frequency scan will continue (refer to paragraph 3-37) until the scan high frequency limit is attained, at which time scan direction control flip-flop A212 will be switched to its "reset" state, energizing scan direction control relay K101 and causing the servomotor to reverse its direction of rotation. The down-frequency scan will have the same rate as the up-frequency scan. Once the scan low frequency limit is reached, A212 will be once again placed in the "set" state and the servomotor will again drive the tuner up in frequency. This process will continue as long as S205 is set to SECTOR. Note that depression of the SWEEP REVERSE pushbutton switch will reverse the scan direction when the tuner is scanning either up or down in frequency. If a scan is begun with a tuner outside the scan limit frequencies, the SWEEP REVERSE switch will not toggle the scan direction control flip-flop since the applicable limit voltage comparator will maintain the flip-flop in its "set" or "reset" state until the analog x voltage becomes such as to switch the comparator. Notice that the scan direction will always be such as to bring the tuner within the scan limits, at which time the operator can reverse scan direction at will. The sweep can be interrupted by rotating the SWEEP RATE control fully counterclockwise to OFF, thereby setting the sweep rate drive at ground. The continuous sector scan capability can be discontinued only by setting the SWEEP MODE switch to either SINGLE or MANUAL.

3-44. When the operator sets AFC switch S212 to ON and adjusts the SIGNAL THRESHOLD control for

a particular threshold level, the equipment will scan normally until a signal exceeding the preprogrammed threshold level is intercepted. The interception of such a signal will cause the signal present voltage comparator (A213, refer to paragraph 3-47) to switch states, energizing signal present control relay K208 which, in turn, energizes signal present control relay K210. Closure of K210 contacts 10-6 causes SIGNAL PRESENT indicator lamp DS203 to illuminate and the opening of K208 contacts 10-2 interrupts the application of +27 volts to the coil of K205. When K205 is de-energized, contacts 8-12 open to break the sweep rate control voltage path between the wiper of R230 and servo bipolar chopper and preamplifier A103, thereby causing the servomotor to stop.

3-45. Setting the AFC switch to ON couples +27 volts through normally-closed contacts 10-2 of K202 and terminals 13 and 14 of S205B across the coil of electronic afc control relay K103, causing contacts 9-1 of K103 to open and contacts 9-5 to close, coupling the output of operational amplifier A115 to A103 instead of the drive voltage from R230. Any drift in the intercepted signal frequency will produce a d-c error voltage (refer to paragraph 3-57) which is coupled simultaneously to afc bipolar chopper A106 (refer to paragraph 3-62) and to afc operational amplifier A115 (refer to paragraph 3-66).

3-46. CLOCK OSCILLATOR A102. The pulses necessary to actuate band selector stepping switch S101 are controlled by clock oscillator A102 (see figure 5-3). The clock oscillator consists of astable multivibrator Q1 and Q2, amplifier Q3 and switch Q4. The voltage at the drain of Q2, a square wave whose amplitude switches between ground and +12 volts at a 1-Hz rate, alternately driving amplifier Q3 between its saturation and cutoff states. During the interval when the drain of Q2 is at ground, the base-to-emitter junction of Q3 is not forward biased and the transistor is therefore cutoff with its collector at +12 volts. This causes Q4 to be driven into saturation, placing its collector at virtual ground, thereby permitting down-frequency stepping control relay K104 or up-frequency stepping control relay K105 to become momentarily energized. When the astable multivibrator switches states the drain of Q2 rises to +12 volts, forward biasing the base-to-emitter junction of Q3 and causing it to conduct heavily. This places the collector of Q3 at virtual ground, cutting off Q4 and de-energizing relay K104 or K105.

3-47. VOLTAGE COMPARATORS. Five identical voltage comparators (see figure 5-13) are employed in the Data Evaluation Unit circuitry. The voltages which each compares are tabulated in table 3-2; the operation of each comparator is described in paragraph 3-48.

TABLE 3-2. VOLTAGE COMPARATOR FUNCTIONS

Voltage Comparator	Function
Peak Level Voltage Comparator A208	Compares peak voltage of charged memory capacitor with incoming signal. When the former exceeds the latter by more than a preprogrammed amount, the comparator switches states to discharge the memory capacitor and initiate a new peak hold cycle. Refer to paragraph 3-96.
Signal Present Voltage Comparator A213	Compares analog y voltage with level set by SIGNAL THRESHOLD control R224. When the former exceeds the latter, the voltage comparator switches states, causing the SIGNAL PRESENT indicator lamp to illuminate and (when employing the automatic continuous sector scan mode of operation), interrupts the scanning mechanism. Refer to paragraph 3-44.
Crossover Voltage Comparator A214	Compares the voltages programmed by the settings of LOWER LIMIT control R234 and UPPER LIMIT control R236. When the former equals or exceeds the latter, the comparator switches states, causing CROSSOVER indicator lamp DS202 to illuminate and simultaneously disable the scanning mechanism. Refer to paragraph 3-36.
Low Frequency Analog Voltage Comparator A215	Compares the analog x output voltage of the selected tuner with that programmed by the setting of the LOWER LIMIT control. When the latter equals or exceeds the former, the comparator switches states, placing scan direction control flip-flop A212 in the

(Cont'd)

TABLE 3-2. VOLTAGE COMPARATOR FUNCTIONS (Cont'd)

Voltage Comparator	Function
Low Frequency Analog Voltage Comparator A215 (Cont'd)	"set" state (i.e., scan up frequency). Refer to paragraph 3-33.
High Frequency Analog Voltage Comparator A216	Compares the analog x output voltage of the selected tuner with that programmed by the setting of the UPPER LIMIT control. When the former equals or exceeds the latter, the comparator switches states, placing scan direction control flip-flop A212 in the "reset" position (i.e., scan down frequency). Refer to paragraph 3-37.

3-48. The voltages being compared are each coupled to the inputs of an emitter-coupled differential amplifier (Q1 through Q4 and Q7). As long as the voltage at the base of Q1 is more positive than that at the base of Q4, amplifier Q5 will be cut off and its collector will be at ground. This places switch Q6 in cutoff and its collector at +24 volts. When the voltage at the base of Q4 equals or exceeds that at the base of Q1, Q5 starts to conduct, causing its collector voltage to become positive enough to drive Q6 into saturation, thereby placing its collector at ground. When the voltage at the base of Q4 once again becomes less than that at the base of Q1, Q6 will switch back to its cutoff state.

3-49. SCAN DIRECTION CONTROL FLIP-FLOP A212. The direction assumed by the scan drive motor is controlled by the output of scan direction control flip-flop A212 (see figure 5-17). Bistable multivibrator Q1 and Q2 can be in one of two stable states: either Q1 on and Q2 off ("reset" state) or Q2 on and Q1 off ("set" state).

3-50. When the bistable is in the "reset" state, Q2 is cutoff (placing its collector at approximately +17 volts) and Q1 is conducting. The voltage at the base of Q1 is equal to the sum of the forward biased base-emitter junction voltage in series with the voltage across forward biased diode CR7. Since Q2 is cutoff, switch Q3 is conducting heavily, placing its collector at ground and thereby energizing scan direction control relay K101, causing the scan mechanism (when energized) to scan down in frequency. When the analog x output voltage from the selected tuner is equal to or less than that programmed by the setting of LOWER LIMIT control R234, the output of low frequency analog voltage comparator A215 (refer to paragraph 3-47) switches from +24 volts to ground. As this voltage nears ground, diode CR2 becomes forward biased causing the base voltage at Q1 to drop slightly closer to ground, tending to reverse bias the base-emitter junction. As the base voltage becomes closer to ground, the collector voltage of Q1 rises and the regenerative action of the bistable places Q1 in cutoff and Q2 in saturation ("set" state).

3-51. Should the bistable be in the "reset" state with the LOWER LIMIT control set fully counterclockwise, when the band 1 tuner reaches the low end of its range cam-actuated switch A124S1 will close and couple -24 volts to the base of Q1, instantly placing the bistable in the "set" state. Transition of the bistable from the "set" to "reset" states is accomplished in a similar manner, with the trigger being applied to the base of Q2.

3-52. Toggling of the bistable is accomplished by the application of a -12 volt pulse (when the SWEEP REVERSE pushbutton switch is depressed) simultaneously to the base of Q1 and Q2. This negative voltage has no effect on the cutoff stage but causes the conducting stages to be driven into cutoff.

3-54. When the bistable is in the "set" state, Q3 is cutoff and its collector is at +24 volts. Since the voltage across the coil of scan direction control relay K101 (3 volts) is not sufficient to maintain the relay energized, the relay drops out and the scan mechanism is set for an up-frequency scan.

3-55. DETAILED CIRCUIT ANALYSIS, AFC LOOPS. (See Figure 3-5.)

3-56. Two automatic frequency control (afc) loops are employed in the EMA-910. One loop (refer to paragraphs 3-57 through 3-64) electronically adjusts the operating frequency of the reflex klystron local oscillator by superimposing a correction voltage upon the existing repeller voltage, thereby providing afc over a relatively narrow frequency range. This loop is activated by setting the AFC switch to ON when the SWEEP MODE switch is set to either MANUAL or SECTOR. The second loop (refer to paragraphs 3-65 through 3-69) electromechanically adjusts the operating frequency of the local oscillator by simultaneous adjustment of the cavity length and repeller voltage. This loop, which operates in conjunction with the electronic afc loop, is activated when the AFC switch is set to ON and the applied r-f signal is of sufficient amplitude to cause the SIGNAL PRESENT indicator lamp to illuminate. Unlike the electronic afc loop, the electromechanical afc loop is activated only when the SWEEP MODE switch is set to SECTOR.

3-57. 60-MHZ I-F AMPLIFIER/AFC DISCRIMINATOR A222. The second i-f signal from the 60-MHz logarithmic i-f amplifier (refer to paragraph 3-84)

is coupled to the input of 60-MHz i-f amplifier/afc discriminator A222 (see figure 5-21) and undergoes two stages of amplification (Q1 and Q2) at 60 MHz. Diodes CR1 and CR2 limit the signal, thereby eliminating amplitude noise components while simultaneously providing a driving signal that is independent of variations in applied signal strength. The limited output of Q2 is then simultaneously applied to two parallel-resonant tank circuits -- L9, C11 and C36 (tuned to 66 MHz) and L10, C13 and C37 (tuned to 52 MHz) -- each driving a diode detector. The phasing of the detector diodes is such that the algebraic sum of their outputs provides a frequency discriminator which furnishes a d-c voltage linearly proportional to the deviation from the desired second i-f center frequency of 60 MHz.

3-58. When the second i-f is centered at exactly 60 MHz, the voltages developed across each tank circuit are of equal amplitude. The detected signals, however, are of opposite polarity and their algebraic sum is zero. Should the applied r-f signal drift in that direction to produce a second i-f signal greater than 60 MHz (see table 3-3), the voltage developed across the 66-MHz tank circuit will be greater than that developed across the 52-MHz tank. This causes the output of detector CR3 to be more positive than the output of CR4 is negative, with a resulting sum voltage that is positive. Conversely, should the applied r-f signal drift in that direction to produce a second i-f signal less than 60 MHz, the voltage developed across the 52-MHz tank will be more negative than the voltage across the 66-MHz tank is positive, thereby providing a sum voltage that is negative.

3-59. The discriminator output voltage is then applied to inverting operational amplifier MC1 which drives complementary-symmetry emitter follower Q4 and Q5 through buffer amplifier Q6. The slope of the discriminator output is adjusted at 1v/MHz by the tuning of the tank circuits and R48 sets the output at zero volts when the second i-f is centered at 60 MHz. The discriminator output is simultaneously applied to FM connector J250 (where it is available for oscilloscopic observation of the applied signal modulation content) and to afc bipolar pulse stretcher A211 (refer to paragraph 3-60).

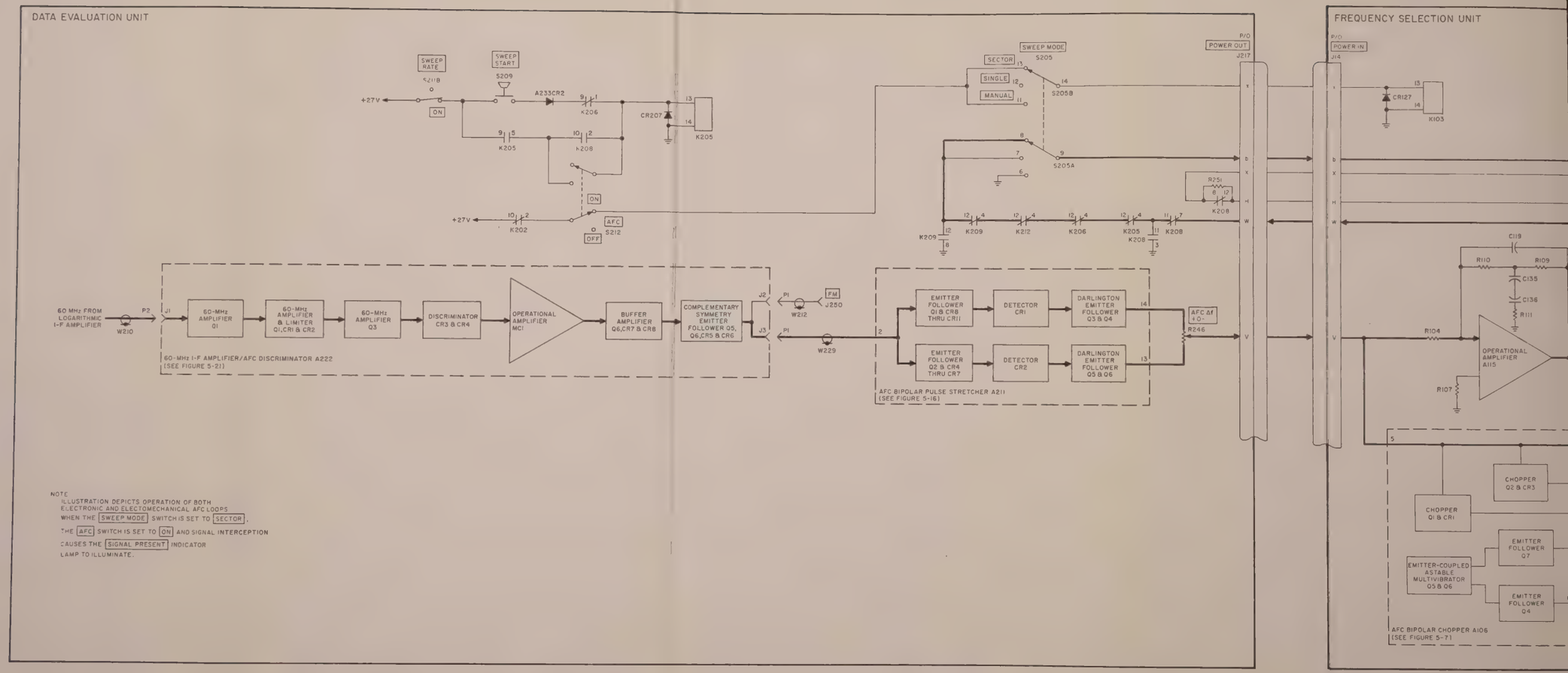
3-60. AFC BIPOLAR PULSE STRETCHER A211. The d-c output of 60-MHz i-f amplifier/afc discriminator A222 is applied to afc bipolar pulse stretcher A211 (see figure 5-16). The complementary configuration of the circuit provides a balanced output at pins 13 and 14 for a zero volt input at pin 2. Positive input levels are coupled through forward biased diodes CR4 through CR11 to the bases of emitter followers Q1 and Q2, causing their emitters to become more positive. These positive-going voltages are coupled through diodes CR1 and CR2 to Darlington emitter followers Q3/Q4 and Q5/Q6, respectively, causing their emitters to become positive. Note that the phasing of diode CR2 limits the positive voltage excursion at the emitter of Q6 and, for all intents and purposes, it can be considered as being at ground potential.

3-61. The positive voltage at the emitter of Q4 is impressed across Δf potentiometer R246. The voltage appearing at the wiper of R246, adjustable about zero, is applied to afc bipolar chopper A106 (refer to paragraph 3-62). Conversely, when the input to the afc bipolar pulse stretcher is negative, the voltage at the emitter of Q6 becomes negative while the voltage at the emitter of Q4 remains essentially at ground, thereby impressing a negative voltage across R246.

3-62. AFC BIPOLAR CHOPPER A106. Astable multivibrator Q5 and Q6 (see figure 5-7), in conjunction with emitter followers Q4 and Q7, generates two non-symmetrical nominally 50 kHz pulse trains employed to chop the d-c output of afc bipolar pulse stretcher A211. When either the band 1 or band 3 tuner is operative, afc control relay K109 is energized and the output of emitter follower Q7 (see figure 3-6a) is a-c coupled (through closed contacts 5-9 of K109 and capacitor C2) to the base of chopper Q2 while the output of emitter follower Q4 (see figure 3-6b) is coupled (through closed contacts 8-12 of K109 and capacitor C1) to the base of chopper Q1. The a-c coupling causes both choppers to be driven into saturation at the same time. Note that both Q1 and Q2 are maintained in their saturation regions for the greater part of the multivibrator period, thereby enabling the choppers to develop positive (or negative) output pulses from a positive (or negative) d-c input voltage. When either the band 2 or band 4 tuner is operative, the output of the emitter followers are switched (i. e., Q4 now drives Q2 and Q7 drives Q1). The reversal of the driving pulses causes the choppers to be driven into saturation during a fraction of the multivibrator period, thereby producing negative (or positive) pulses from a positive (or negative) d-c input (See table 3-2.)

3-63. AFC PULSE AMPLIFIER A101. The output pulses of afc bipolar chopper A106 are applied to afc pulse amplifier A101 (see figure 5-2) where they undergo amplification (Q1 and Q2), resulting in an inverted output. The overall gain of the pulse amplifier is adjusted by multiturn potentiometer R2. The output of the pulse amplifier is capacitively coupled to the repeller voltage adding network of the operative tuner, where it is superimposed (after detection) upon the existing repeller voltage to cause the klystron operating frequency to shift in that direction which tends to return the second i-f to 60 MHz.

3-64. If the applied r-f signal (in band 2 or 4 operation) drifts by an amount Δf (within the electronic tuning range of the klystron) and remains at the frequency $f_{r-f} + \Delta f$ (as illustrated in figure 3-7a), the second i-f increases in frequency and both the afc error voltage and afc pulse stretcher voltages are negative. The afc bipolar chopper develops positive pulses which, after amplification and inversion by the afc pulse amplifier, is superimposed upon the klystron repeller voltage, causing the klystron operating frequency to shift in that direction which tends to return the second i-f to 60 MHz. The process is continued, due to the relatively long


DATA EVALUATION UNIT
SWEEP RATE
S211B
ON
SWEEP START
S209
+27V
A233CR2
K206
CR207
K205
K208
ON
AFC
S212
OFF
+27V
K202
SWEEP MODE
S205
SECTOR
SINGLE
MANUAL
S205B
S205A
P/O
POWER OUT
J217
R251
K208
K209
K209
K212
K206
K205
K208
K208
60 MHz FROM LOGARITHMIC I-F AMPLIFIER
P2
W210
J1
60-MHz AMPLIFIER Q1
60-MHz AMPLIFIER & LIMITER Q1,CR1 & CR2
60-MHz AMPLIFIER Q3
DISCRIMINATOR CR3 & CR4
OPERATIONAL AMPLIFIER MC1
BUFFER AMPLIFIER Q6,CR7 & CR8
COMPLEMENTARY SYMMETRY EMITTER FOLLOWER Q5, Q6,CR5 & CR6
J2
J3
P1
W212
FM
J250
P1
W229
60-MHz I-F AMPLIFIER/AFC DISCRIMINATOR A222
(SEE FIGURE 5-21)
EMITTER FOLLOWER Q1 & CR8 THRU CR11
DETECTOR CR1
DARLINGTON EMITTER FOLLOWER Q3 & Q4
EMITTER FOLLOWER Q2 & CR4 THRU CR7
DETECTOR CR2
DARLINGTON EMITTER FOLLOWER Q5 & Q6
AFC Δf
40
R246
AFC BIPOLAR PULSE STRETCHER A211
(SEE FIGURE 5-16)
NOTE
ILLUSTRATION DEPICTS OPERATION OF BOTH ELECTRONIC AND ELECTOMECHANICAL AFC LOOPS WHEN THE SWEEP MODE SWITCH IS SET TO SECTOR. THE AFC SWITCH IS SET TO ON AND SIGNAL INTERCEPTION CAUSES THE SIGNAL PRESENT INDICATOR LAMP TO ILLUMINATE.
FREQUENCY SELECTION UNIT
P/O
POWER IN
J14
CR127
K103
C119
R110
R109
C135
C136
R111
R104
OPERATIONAL AMPLIFIER A115
R107
CHOPPER Q2 & CR3
CHOPPER Q1 & CR1
EMITTER FOLLOWER Q7
EMITTER-COUPLED ASTABLE MULTIVIBRATOR Q5 & Q6
EMITTER FOLLOWER Q4
AFC BIPOLAR CHOPPER A106
(SEE FIGURE 5-7)

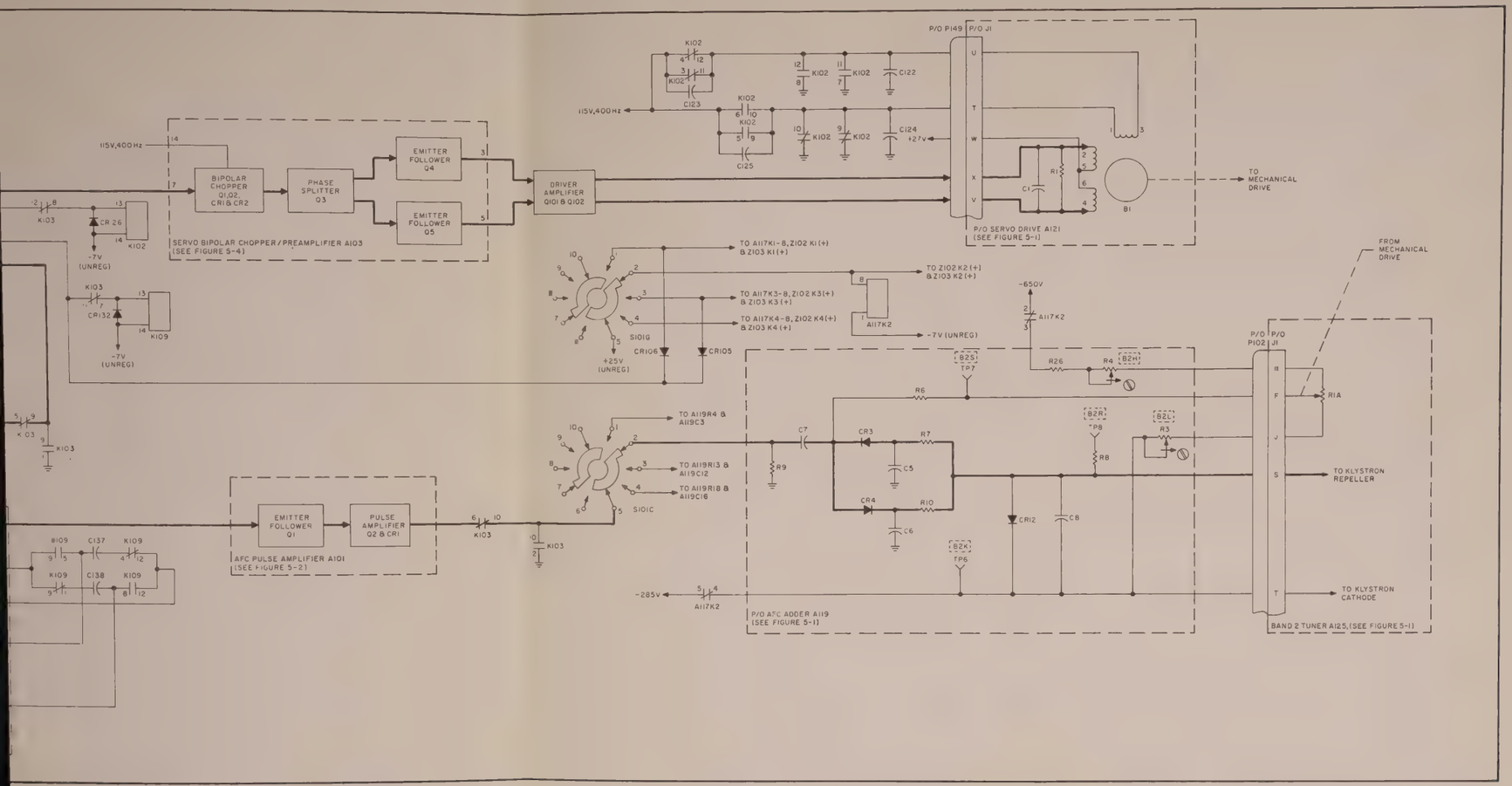


Figure 3-5. Afc Circuitry, Detailed Block Diagram

TABLE 3-3. ELECTRONIC AFC SEQUENCE OF EVENTS

	Bands 1 & 3 (Local oscillator 240 MHz above applied r-f signal)		Bands 2 & 4 (Local oscillator 240 MHz below applied r-f signal)	
	If applied r-f signal increases	If applied r-f signal decreases	If applied r-f signal increases	If applied r-f signal decreases
First i-f signal frequency	Decreases	Increases	Increases	Decreases
Second i-f signal frequency	Decreases	Increases	Increases	Decreases
Afc discriminator voltage polarity	Negative	Positive	Positive	Negative
Afc error voltage polarity	Positive	Negative	Negative	Positive
Afc pulse stretcher output voltage polarity	Positive	Negative	Negative	Positive
Afc bipolar chopper output	Positive pulses	Negative pulses	Positive pulses	Negative pulses
Afc pulse amplifier output	Negative pulses	Positive pulses	Negative pulses	Positive pulses
Local oscillator repeller voltage	More negative	Less negative	More negative	Less negative
Local oscillator frequency	Increases	Decreases	Increases	Decreases

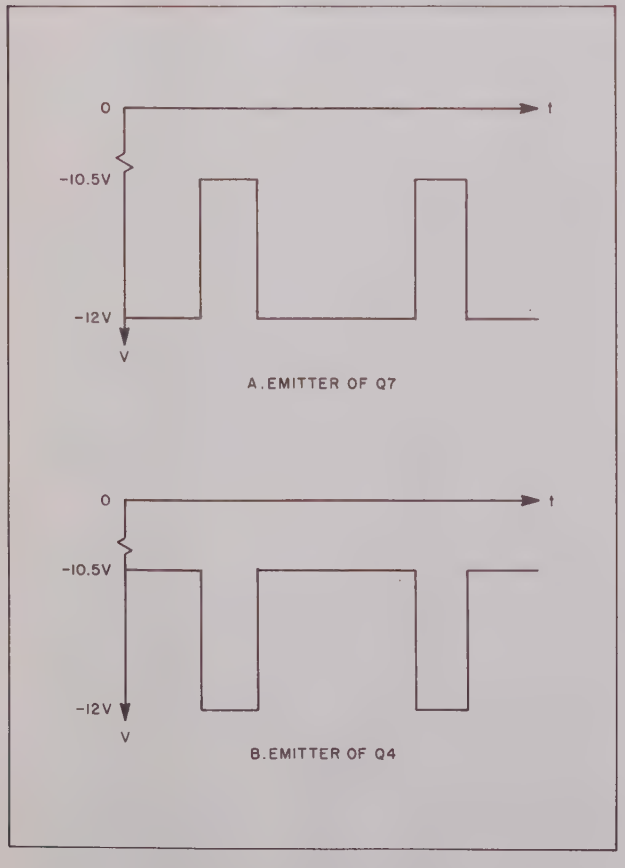


Figure 3-6. Multivibrator Output Waveforms

discharge time constant of the repeller adder network, until the reflex klystron frequency is pulled to the point where it is separated by nearly 240 MHz from the applied r-f signal.

3-65. Should the applied r-f signal drift continue in the same direction, the linear region of the klystron electronic tuning characteristics will be exceeded (see figure 3-8) and the electronic afc loop will no longer be capable of pulling the klystron frequency. If this occurs when the SWEEP MODE switch is set to MANUAL, the signal will be lost. However, if this occurs when the SWEEP MODE switch is set to SECTOR (after signal present conditions have been established), the afc bipolar pulse stretcher output is applied to afc operational amplifier A115 (refer to paragraph 3-66).

3-66. AFC OPERATIONAL AMPLIFIER A115. When the applied r-f signal drifts (when the SWEEP MODE switch is set to SECTOR and signal present conditions have been established) beyond the linear range of the klystron pull-in characteristics, the output of afc bipolar pulse stretcher A211 increases. This voltage is applied to afc operational amplifier module A115 which simultaneously amplifies and inverts the phase of the signal. The output of A115 is d-c coupled to servo bipolar chopper/preamplifier A103 (refer to paragraph 3-67).

3-67. SERVO BIPOLAR CHOPPER/PREAMPLIFIER A103. The output of afc operational amplifier A115 is coupled through resistor R2 of servo bipolar chopper/preamplifier A103 (see figure 5-4) to the junction of diodes CR1 and CR2, resistor R9 and the base of phase splitter Q3. A 115-volt 400-Hz

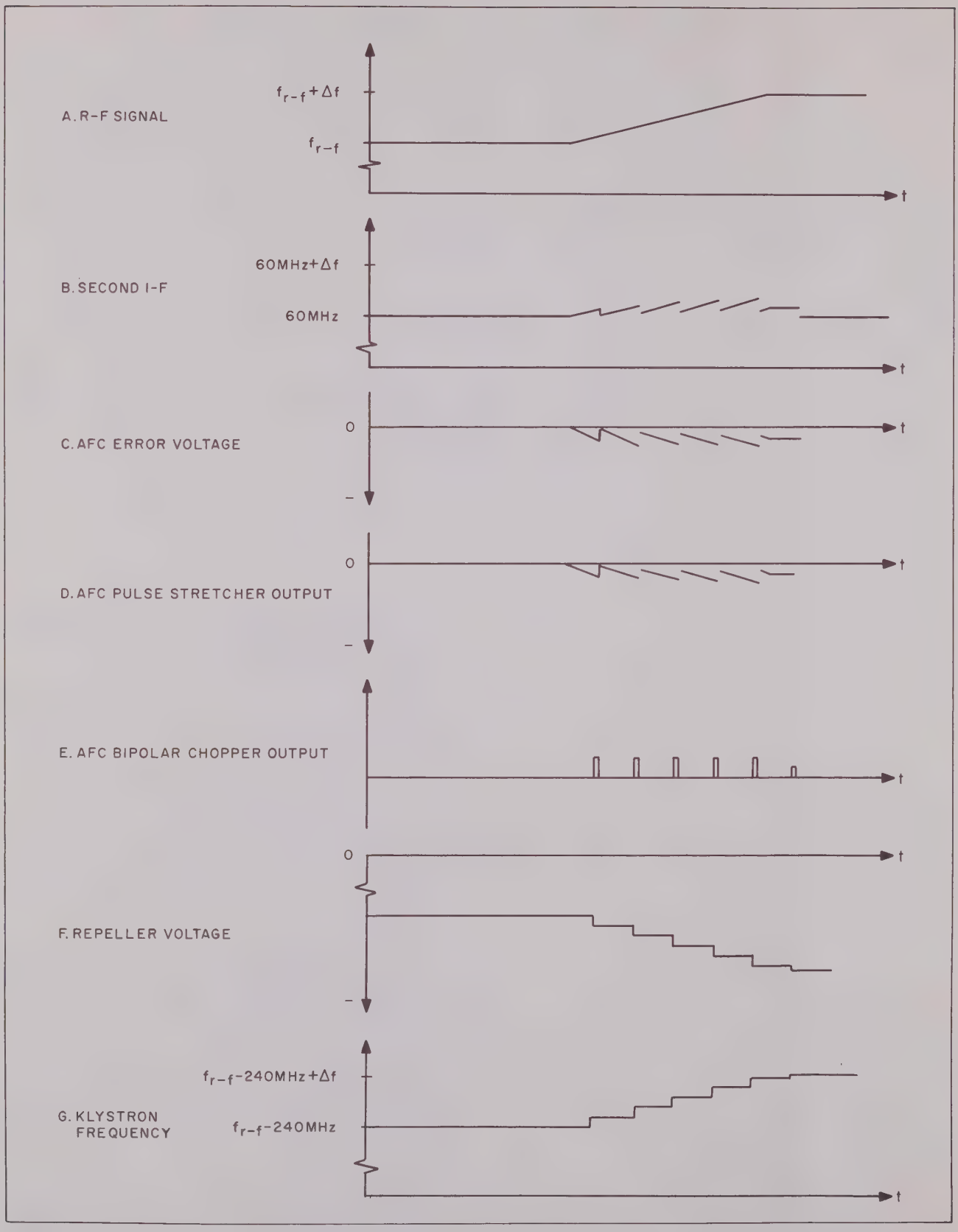


Figure 3-7. Typical Frequency and Voltage Changes Produced by Electronic Afc Loop (Band 2 or 4 Tuner Operative)

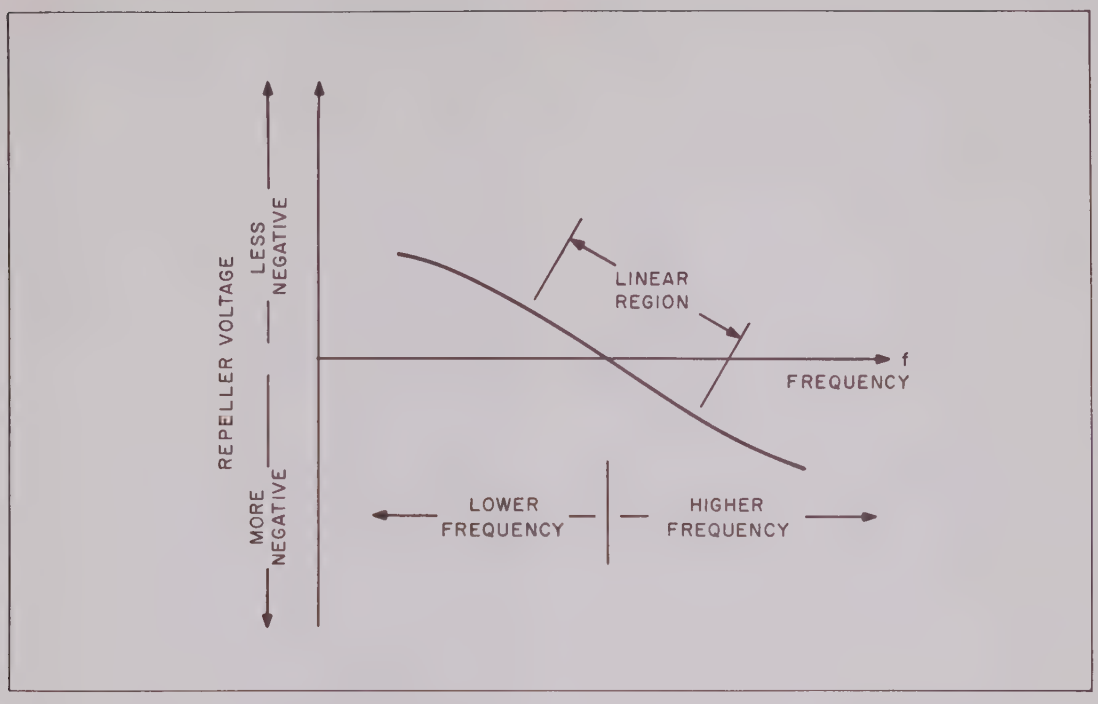


Figure 3-8. Typical Klystron Electronic Tuning Characteristics

square-wave is simultaneously applied to the base of chopper Q1 through the voltage divider consisting of R3, R5 and R6.

3-68. During the negative half-cycle of the square wave, Q1 is biased into cutoff and, in the absence of an input signal, its collector is at approximately +6.5 volts (due to the +24 volt supply and the voltage divider consisting of R4 and R7). When the square wave switches to its positive half-cycle, Q1 is driven into saturation, placing its collector at ground. The resulting negative-going step voltage is coupled through capacitor C5 to the base of chopper Q2, driving it into saturation. Since the time constant of R8 and C5 is much greater than the 400-Hz square-wave period, Q2 remains saturated until the square-wave once again becomes negative to simultaneously drive both Q1 and Q2 into cutoff.

3-69. The alternation between cutoff and saturation of choppers Q1 and Q2 results in the generation of a train of square pulses (ground referenced) from the applied afc bipolar pulse stretcher output level. Thus, for positive inputs, the chopper develops a positive square wave, while a negative square wave is obtained from a negative input. The resulting square-wave output of the chopper is coupled to phase splitter Q3, which furnishes both an in-phase and inverted output of equal amplitude. These two signals are coupled through emitter followers Q4 and Q5 to servo driver amplifiers Q101 and Q102, which causes servo-motor A121B1 to rotate in that direction that will mechanically tune the klystron and subsequently return the second i-f to 60 MHz.

3-70. DETAILED CIRCUIT ANALYSIS, I-F, VIDEO AND METERING SECTIONS. (See Figure 3-9.)

3-71. 240-MHZ SIGNAL SAMPLER. The 240-MHz first i-f signal from the Frequency Selection Unit is coupled through Data Evaluation Unit 240 MHZ INPUT connector J249 and applied to a passive signal sampler (see figure 5-23). Capacitor A224C1 and resistor A224R9 form a voltage divider tied to the first i-f line. The sampled signal, taken across A224R9, is coupled to 240 MHZ OUT connector J253 where it is available for application to auxiliary test equipment such as a spectrum signature pan-adaptor. Note that the sampled signal is obtained before band limiting filter FL201 (refer to paragraph 3-72), thereby providing a display having maximum fidelity. The sampler provides approximately 20 dB of isolation between J253 and the first i-f line to minimize the loading effects caused by the coupling of auxiliary test equipment.

3-72. 240-MHZ BANDPASS FILTER FL201. The unattenuated output of the 240-MHz signal sampler is applied to FL201, a lumped-element, multi-section bandpass filter which establishes an uncalibrated full i-f bandwidth of approximately 10 MHz. The band limited output of the filter is coupled to Z201 (refer to paragraph 3-73).

3-73. 240-MHZ I-F ATTENUATOR. The output of FL201 is applied to Z201 which routs the signal, either directly or through a 20-dB attenuator (depending on the settings of MULTIPLIER switch S203

and CALIBRATE pushbutton switch S213), to 240/60-MHz mixer A225 (refer to paragraph 3-76). When the CALIBRATE pushbutton switch is not depressed and the MULTIPLIER switch is set to any position other than $X10^2$ +40 DB or $X10^4$ +80 DB, the relay of Z201 is unenergized and the signal is coupled directly through Z201 and applied to A225. When the MULTIPLIER switch is set to $X10^2$ +40 DB or $X10^4$ +80 DB (and the CALIBRATE pushbutton switch is not depressed), +27 volts is coupled through normally-closed contacts 10-2 of calibrate control relay K202 and steering diode CR208 (and steering diode CR203 when S203 is set to $X10^4$ +80 DB), energizing the relay of Z201 and routing the first i-f signal to A225 through a 240-MHz 20-dB attenuator (refer to paragraph 3-74). When the CALIBRATE pushbutton switch is depressed, calibrate control relay K202 is energized, causing contacts 10-2 to open and interrupt the application of +27 volts to the relay of Z201 and the first i-f signal is coupled directly to A225 regardless of the setting of the MULTIPLIER switch. Note that, if the MULTIPLIER switch was set to either $X10^2$ +40 DB or $X10^4$ +80 DB, the 240-MHz 20-dB attenuator will be re-inserted into the first i-f signal path upon releasing the CALIBRATE pushbutton switch.

3-74. The 240-MHz 20-dB attenuator (see figure 5-23) consists of resistors R5, R7 and R8 and variable resistor R6 which are interconnected to form a symmetrical T-section attenuator. The insertion loss of the attenuator is set at 20 dB by adjustment of R6.

3-75. 240/60-MHZ MIXER A225. The 240-MHz first i-f signal from Z201 is then applied to 240/60-MHz mixer A225 (see figure 5-24) where it is coupled to crystal mixer CR1 through a bandpass filter consisting of C1, C2, C3, L1 and L2. The 180-MHz output of crystal-controlled oscillator A226 (refer to paragraph 3-76) is simultaneously applied to the mixer diode through the series-resonant circuit consisting of capacitor C4 and variable inductor L3. The non-linear characteristics of the mixer diode generates the sum and difference modulation products of the applied signals as well as the sum and difference modulation products of their harmonics. The mixer outputs are applied to a low-pass filter (L4, L5, L6, C6, C7 and C14) which attenuates all modulation products other than the desired 60-MHz difference frequency (second i-f) signal. This signal is coupled through tuned amplifier Q1 and applied to a 60-MHz attenuator (refer to paragraph 3-77). The 240/60-MHz mixer has a conversion gain of approximately 8 dB.

3-76. CRYSTAL-CONTROLLER OSCILLATOR A226. The crystal-controlled oscillator (see figure 5-25) generates a 180-MHz cw signal that is employed to heterodyne with the 240-MHz first i-f signal to develop the second i-f at 60 MHz. The oscillator consists of crystal Y1, transistor Q1 and associated circuitry arranged in a common-base Colpitts configuration. The 90-MHz output of oscillator Q1 is applied to frequency doubler Q2 which develops an output that is rich in harmonics. Since the collector tank circuit is tuned to the first harmonic (180 MHz), all other harmonics, as well as the 90-MHz fundamental, are attenuated. A series-resonant circuit (C12 and L5) tuned to 180-MHz further attenuates the unwanted harmonics and passes only the desired 180-MHz signal to 240/60-MHz mixer A225.

3-77. 60-MHZ I-F ATTENUATOR. The output of A225 is applied to Z202 which routs the second i-f signal, either directly or through a 20-dB attenuator (depending on the settings of MULTIPLIER switch S203 and CALIBRATE pushbutton switch S213), to 60-MHz linear i-f amplifier A220 (refer to paragraph 3-78). When the MULTIPLIER switch is set to $X10^0$ +0 DB and the CALIBRATE pushbutton switch is not depressed, the relay of Z202 is unenergized and the second i-f signal is coupled directly to A220. When the MULTIPLIER switch is set to any other position (and the CALIBRATE pushbutton switch is not depressed), +27 volts is coupled through normally-closed contacts 10-2 of calibrate control relay K202, one or more steering diodes CR202, CR203, CR208 and/or CR209) and S203, thereby energizing Z202 and routing the signal to A220 through a 60-MHz 20-dB attenuator. Note that when the CALIBRATE pushbutton switch is depressed, contacts 10-6 of K202 close to couple +27 volts to the relay of Z202 (regardless of the setting of the MULTIPLIER switch). Releasing the MULTIPLIER pushbutton switch returns Z202 to the condition determined by the setting of the MULTIPLIER switch.

3-78. The 60-MHz 20-dB attenuator (see figure 5-23), like the 240-MHz 20-dB attenuator, consists of four resistive elements (R1 through R4) forming a symmetrical T attenuator. R2 sets the insertion loss at 20 dB.

3-79. 60-MHZ LINEAR I-F AMPLIFIER A220. The second i-f signal from Z202 is then applied to 60-MHz linear i-f amplifier A220 (see figure 5-19), a four-stage adjustable gain linear tuned amplifier. The first stage, MC1, is an integrated circuit linear amplifier employed as a common-emitter common base cascode circuit. The gain of the integrated circuit is controlled by the setting of BANDWIDTH switch S202 (refer to paragraph 3-81) to compensate for insertion loss variations between i-f bandwidth limiting filters. The output of MC1 is further amplified by Q1, Q2 and Q3, three conventional self-biased tuned amplifiers.

3-80. The overall gain of the linear i-f amplifier is continuously variable between 20 and 50 dB by a tandem adjustable resistor (CR1, CR4 and associated circuitry) through IF GAIN control R260. When the IF GAIN control is rotated fully clockwise, its wiper is at -24 volts and diodes CR1 and CR4 are both forward-biased and conducting maximum direct current (approximately 1 ma). The dynamic resistance (slope of the diode E-I characteristic curve) is at a minimum, thereby permitting maximum signal current transfer to the base of Q2 and hence maximum gain. As the IF GAIN control is rotated counterclockwise, the current through each diode decreases and the diode dynamic resistance increases, thereby reducing the current transfer to

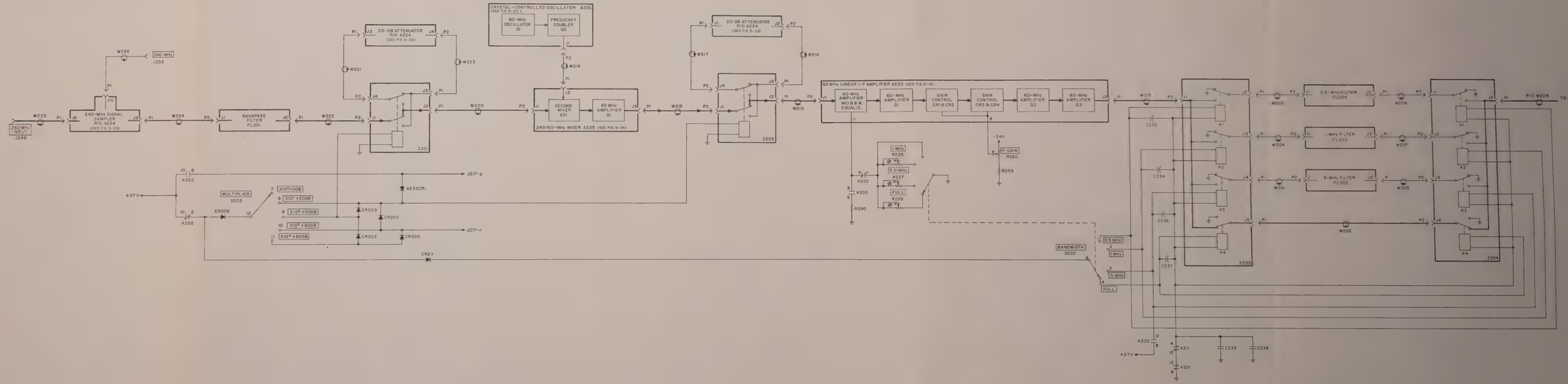
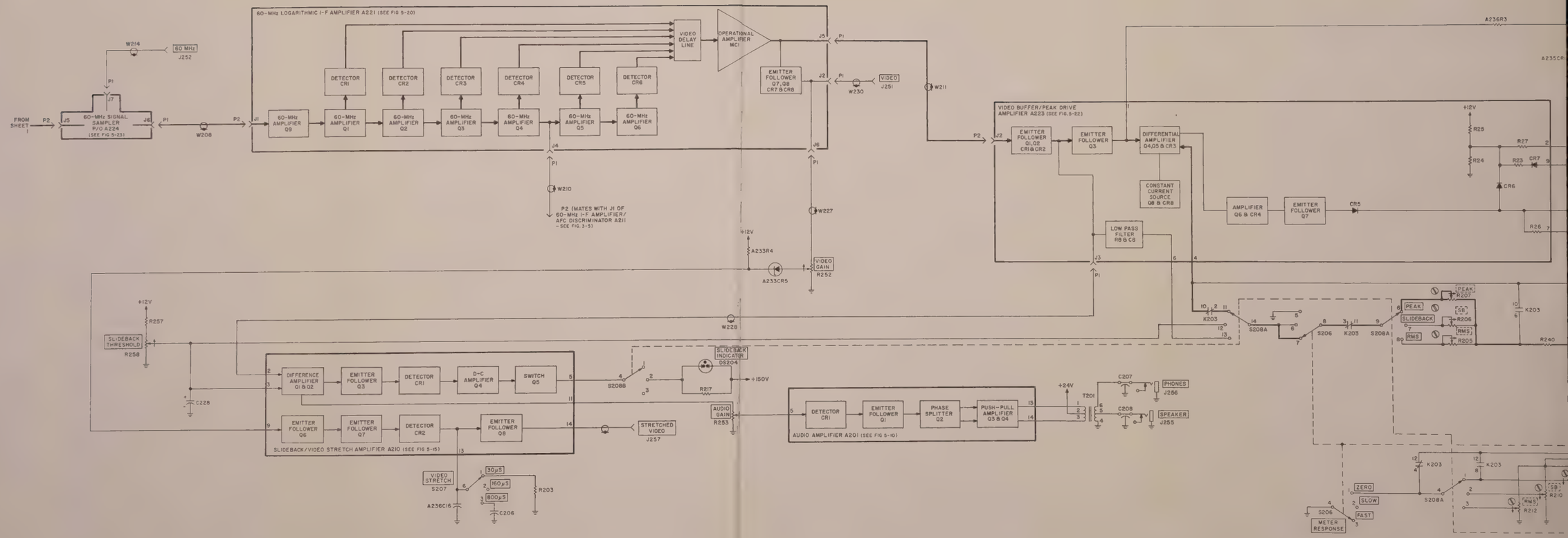
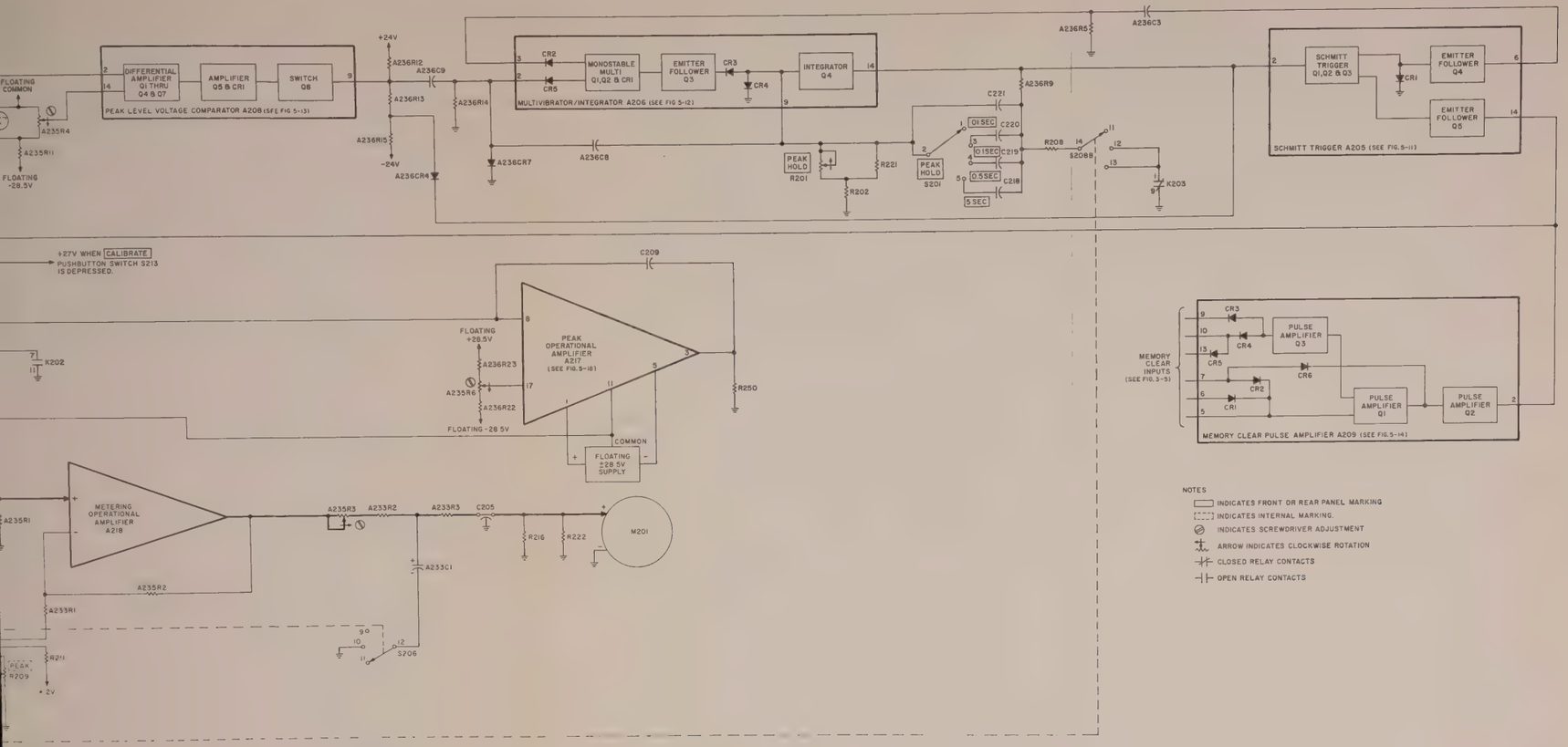


Figure 3-9. I-f, Video and Metering Circuitry, Detailed Block Diagram (Sheet 1 of 2)


60-MHz LOGARITHMIC I-F AMPLIFIER A221 (SEE FIG 5-20)
VIDEO DELAY LINE
OPERATIONAL AMPLIFIER MC1
DETECTOR CR1
DETECTOR CR2
DETECTOR CR3
DETECTOR CR4
DETECTOR CR5
DETECTOR CR6
60-MHz AMPLIFIER Q9
60-MHz AMPLIFIER Q1
60-MHz AMPLIFIER Q2
60-MHz AMPLIFIER Q3
60-MHz AMPLIFIER Q4
60-MHz AMPLIFIER Q5
60-MHz AMPLIFIER Q6
EMITTER FOLLOWER Q7,Q8 CR7 & CR8
W214
60 MHz J252
FROM SHEET
60-MHz SIGNAL SAMPLER P/O A224 (SEE FIG 5-23)
W208
W210
P2 (MATES WITH J1 OF 60-MHz I-F AMPLIFIER/AFC DISCRIMINATOR A211 - SEE FIG. 3-51)
W230
VIDEO J251
W211
W227
+12V
A233R4
A233CR5
VIDEO GAIN R252
VIDEO BUFFER/PEAK DRIVE AMPLIFIER A223 (SEE FIG. 5-22)
EMITTER FOLLOWER Q1,Q2 CR1 & CR2
EMITTER FOLLOWER Q3
DIFFERENTIAL AMPLIFIER Q4,Q5 & CR3
CONSTANT CURRENT SOURCE Q6 & CR8
LOW PASS FILTER R8 & C8
AMPLIFIER Q6 & CR4
EMITTER FOLLOWER Q7
CR5
CR6
CR7
R25
R24
R27
R23
R26
A236R3
A235CR1
W228
+12V
R257
SLIDEBACK THRESHOLD R258
C228
DIFFERENCE AMPLIFIER Q1 & Q2
EMITTER FOLLOWER Q3
DETECTOR CR1
D-C AMPLIFIER Q4
SWITCH Q5
EMITTER FOLLOWER Q6
EMITTER FOLLOWER Q7
DETECTOR CR2
EMITTER FOLLOWER Q8
SLIDEBACK/VIDEO STRETCH AMPLIFIER A210 (SEE FIG 5-15)
S208B
SLIDEBACK INDICATOR DS204
R217
+150V
STRETCHED VIDEO J257
AUDIO GAIN R253
DETECTOR CR1
EMITTER FOLLOWER Q1
PHASE SPLITTER Q2
PUSH-PULL AMPLIFIER Q3 & Q4
AUDIO AMPLIFIER A201 (SEE FIG 5-10)
+24V
T201
C207
C208
PHONES J256
SPEAKER J255
VIDEO STRETCH S207
30µS
160µS
800µS
R203
A236C16
C206
K203
S208A
S206
PEAK R207
SLIDEBACK
RMS
SB
R206
R205
R240
ZERO
SLOW
FAST
METER RESPONSE
R210
R212



NOTES

- INDICATES FRONT OR REAR PANEL MARKING
- INDICATES INTERNAL MARKING.
- INDICATES SCREWDRIVER ADJUSTMENT
- ARROW INDICATES CLOCKWISE ROTATION
- CLOSED RELAY CONTACTS
- OPEN RELAY CONTACTS

Figure 3-9. I-f, Video and Metering Circuitry, Detailed Block Diagram (Sheet 2 of 2)

the base of Q2 and consequently reducing the overall gain of the amplifier.

3-81. I-F BANDWIDTH LIMITING. The overall i-f bandwidth of the equipment is controlled by BANDWIDTH switch S202. Since the bandwidths of both the 240-MHz preamplifier and both the 60-MHz linear i-f amplifier and 60-MHz logarithmic i-f amplifier are broad (in excess of 10-MHz), bandwidth limiting filters are employed so that the equipment can be useful in differentiating between broadband and narrowband applied r-f signals. When the BANDWIDTH switch is set to FULL, relays K4 of both Z203 and Z204 are energized and the output of the 60-MHz linear i-f amplifier is coupled directly to a 60-MHz signal sampler (refer to paragraph 3-83) and bandwidth limiting (approximately 10 MHz) is accomplished by 240-MHz bandpass filter FL201 (refer to paragraph 3-72).

3-82. Lumped-element multi-section bandpass filters FL202, FL203 and FL204 are inserted in the second i-f line to limit the bandwidth of the 60-MHz signal at 5, 1 and 0.5 MHz, respectively. Since the insertion loss of the three filters differ, adjustable resistors R226, R227 and R228 are employed to trim the gain of MC1 in 60-MHz linear i-f amplifier A220 (for a given setting of the IF GAIN control) so that the overall gain of the i-f circuitry is independent of the selected band-limiting filter.

3-83. 60-MHZ SIGNAL SAMPLER. The band-limited second i-f signal is coupled directly to 60-MHz logarithmic i-f amplifier A221 (refer to paragraph 3-84) via a passive signal sampler (see figure 5-23). A portion of the signal is taken at the junction of voltage divider A224C1 and A224R9 and applied to 60 MHZ OUT connector J252, where it is available for application to auxiliary test equipment. This sampler, like the 240-MHz signal sampler, provides 20-dB of isolation between the signal line and the 60 MHZ OUT connector.

3-84. 60-MHZ LOGARITHMIC I-F AMPLIFIER A221. The band-limited 60-MHz second i-f signal from the signal sampler is then applied to 60-MHz logarithmic i-f amplifier A221 (see figure 5-20). After amplification by Q9, the signal is coupled to Q1, the first stage of a six-stage sequentially-limiting i-f amplifier chain. The output of each stage is applied to a diode detector (CR1 through CR6), which feeds a video delay line. Each stage has a gain of 10 dB and saturates at an output level of approximately 1.6 volts. The diode detectors, which have a threshold voltage of 0.5 volts, are d-c coupled to the delay line.

3-85. As the applied signal increases above noise, the output of Q6 exceeds the threshold level of CR6 and the detector contributes to the video delay line (see figure 3-10). As the signal continues to increase, the output of Q6 also increases until it reaches approximately 1.6 volts, at which point the stage is driven into saturation, thereby limiting its contribution to the delay line. As Q6 reaches its saturation point, the output of Q5 is of sufficient amplitude to overcome the threshold voltage of CR5, causing the diode detector to contribute to the delay line. This sequential limiting of amplification and contribution of video continues until the applied signal drives Q1 into saturation.

3-86. The video delay line, which has a frequency response from d-c to 5 MHz, adds the negative video contributions from detectors CR1 through CR6 and couples the summed voltage to inverting operational amplifier MC1. MC1 provides the necessary gain so that the voltage at its output swings from 0 to +6 volts for second i-f input signal level swings from -55 to +5 dBm (60 dB dynamic range). The output of the inverting operational amplifier is simultaneously applied to video buffer/peak driver amplifier A223 (refer to paragraph 3-87) and to complementary-symmetry buffer amplifier Q7 and Q8. The latter serves to provide a low impedance output source for driving both slideback/video stretch amplifier A210 (refer to paragraph 3-99) and VIDEO connector J251. Note that the second i-f signal for driving the afc circuitry is obtained at the output of Q4.

3-87. VIDEO BUFFER/PEAK DRIVER AMPLIFIER A223. The positive video output of 60-MHz logarithmic i-f amplifier A221 is coupled through complementary-symmetry buffer amplifier Q1 and Q2 of video buffer/peak driver amplifier A223 (see figure 5-22) and simultaneously applied to emitter follower Q3 (refer to paragraph 3-88), a low-pass filter and slideback/video stretch amplifier A210 (refer to paragraph 3-99). The low-pass filter, consisting of resistor R8 and capacitor C8, strips the video signal of its time-varying component and passes only the remaining d-c level (which is proportional to the rms value of the applied signal) to metering operational amplifier A218 (refer to paragraph 3-101).

3-88. The output of emitter follower Q3, taken across a video pulse stretcher comprised of R11 and C4, is applied to both peak level voltage comparator A208 (refer to paragraph 3-91) and to the base of Q4, part of an emitter-coupled differential amplifier. The base of Q5, being tied to the common line of the ±28.5 volt floating supply, is at a ground-referenced potential equal to the voltage stored on the peak "memory capacitor" (refer to paragraph 3-90). When the peak value of the incoming video signal is greater than the voltage stored on the "memory capacitor," the base of Q4 becomes more positive than the base of Q5. This causes Q4 to draw more current, lowering its collector voltage. This decrease in collector voltage is coupled through gating diode CR3 to d-c amplifier Q6. The inverted output of Q6 drives emitter follower Q7 into conduction, thereby supplying the current necessary to charge the "memory capacitor" to the peak value of the incoming video signal within 70 nanoseconds. As the voltage across the "memory capacitor" rises, so does the potential (to ground) of the floating ±28.5 volt supply common line. This increasing voltage is fed back to the base of Q5, causing Q7 (through d-c amplifier Q6) to fall back into cutoff (hence supply no further current to charge the "memory capacitor") when the ground-referenced ±28.5 volt

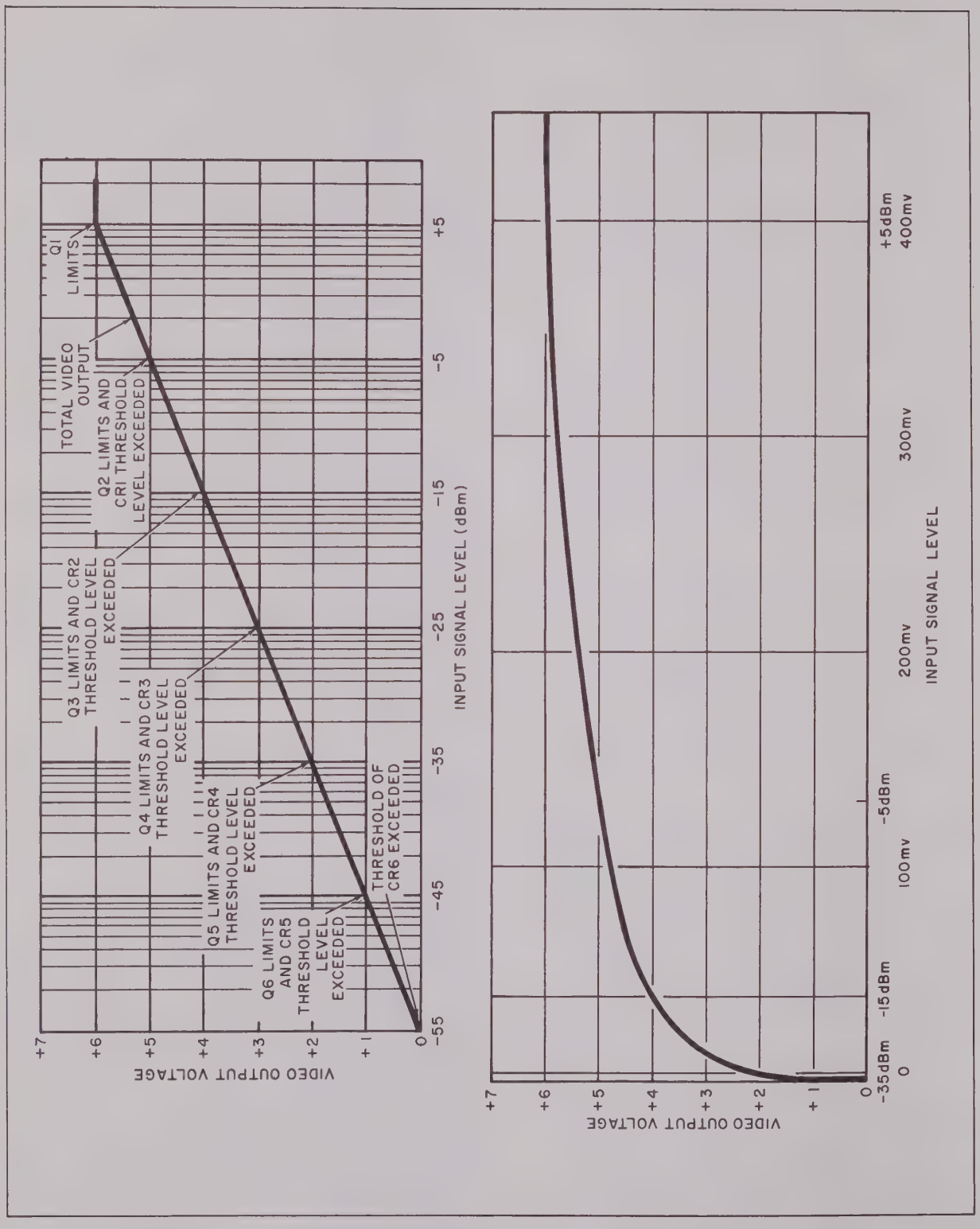


Figure 3-10. 60-MHz Logarithmic I-f Amplifier Transfer Characteristics

floating supply common line is at the same voltage as the incoming video signal.

3-89. Note that once the "memory capacitor" has been charged to the value of the incoming video signal, any decrease in incoming video signal level will back-bias steering diode CR5 (a computor grade diode that exhibits a very low forward resistance while simultaneously providing an extremely high back resistance), thereby preventing the "memory capacitor" from discharging until the peak hold period has elapsed (refer to paragraph 3-91). Note also that the voltage divider consisting of resistors R25 and R24, in conjunction with the +12 volt supply, back-biases discharge diode CR6, another computor diode. When the "memory capacitor" is to be discharged, either upon completion of a peak hold period or by the application of a memory clear signal (refer to paragraph 3-97), pin 2 of the amplifier is placed at virtual ground to forward bias CR6. The "memory capacitor" can now discharge to ground through the low impedance presented by forward-biased diode CR6 and R27. Conversely, when it is desired to have the "memory capacitor" maintain its charge despite the completion of a peak hold period, +27 volts is coupled through steering diode CR7 and resistor R23 to keep discharge diode CR6 back-biased to inhibit the discharge.

3-90. PEAK OPERATIONAL AMPLIFIER A217. The "memory capacitor" which charges to the peak value of the applied video signal consists of high-gain chopper-stabilized d-c amplifier A217 (see figure 5-18) which, in conjunction with feedback capacitor C209, functions as an operational integrator. Although operating power for the peak operational amplifier is obtained from the floating ±28.5 volt supply, the amplifier is ground referenced through R250.

3-91. PEAK HOLD CIRCUITRY. The peak holding circuitry, which consists of peak level voltage comparator A208, multivibrator/integrator A206 and Schmitt trigger A205, is a free-running pulse generator which periodically discharges the peak "memory capacitor." This circuitry is of particular benefit when the EMA-910 is scanning as it permits the peak detector to discharge after responding to an applied signal, thereby permitting it to respond to an adjacent signal of lower level which might otherwise be masked, due to the relatively long discharge time, of conventional peak detectors. See figure 3-11 for the waveforms described in the following paragraphs.

3-92. Multivibrator/Integrator A206. The negative output pulse from emitter follower Q4 of Schmitt trigger A205 (refer to paragraph 3-95) is coupled through capacitor A236C3 and applied to pin 3 of multivibrator/integrator A206 (see figure 5-12). This negative pulse is coupled through steering diode CR2 to the base of Q1, part of a monostable multivibrator. When the multivibrator is in its stable state, Q2 is conducting heavily due to base current being drawn through resistors R2 and R4. Q1 is in cutoff by virture of its base being clamped to ground and its base-emitter junction being reverse-biased. The negative pulse coupled through CR2 forward-biases Q1, driving it into its quasi-stable active region and causing its collector voltage to rise toward ground. The resulting positive-going voltage is coupled to the base of Q2, driving it into cutoff and placing its collector at -24 volts. The regenerative action of this circuit maintains Q1 and Q2 in this quasi-stable state until capacitor C2 discharges through R3 and the forward-biased base-emitter junction of Q1 to allow the multivibrator to reset into its stable state.

3-93. The negative-going output pulse obtained at the collector of Q2 is capacitively coupled to the base of emitter follower Q3, driving the transistor into its saturation region, thus driving the emitter toward -24 volts. Although considerable emitter current is drawn, the loading effect of the timing capacitor strongly clamps the emitter voltage at approximately -2 volts. The resulting negative-going pulse at the emitter of Q3 is coupled through steering diode CR3 driving Q4 into saturation (collector at ground) and discharging the timing capacitor -- C221 or C221 in parallel with C220, C219 or C218, as determined by the setting of PEAK HOLD switch S201. Note that driving the collector of Q4 to ground causes the voltage at the base of Schmitt trigger A205Q1 to fall below the threshold level, thereby causing the trigger to reverse states.

3-94. When the monostable multivibrator reverts back to its stable state, emitter follower Q3 becomes cutoff and the timing capacitor starts to charge through the forward-biased base-emitter junction of integrator Q4. When the base driving voltage becomes insufficient to keep Q4 in saturation, the transistor falls back into its linear region of operation causing its collector voltage to rise negatively as the timing capacitor charges. When the collector voltage reaches approximately -11 volts, the Schmitt trigger threshold voltage is attained and another negative pulse is applied to the multivibrator/integrator to repeat the cycle. Note that the interval between Schmitt trigger output pulses is determined by the R-C time constant selected by the settings of PEAK HOLD switch S201 and PEAK HOLD control R201.

3-95. Schmitt Trigger A205. When the output of multivibrator A206 reaches -11 volts, the threshold voltage of Schmitt trigger A205 (see figure 5-11), the Schmitt trigger (Q1 through Q3) switches states rapidly, causing a negative pulse to develop at the collector of Q3. This negative pulse is coupled through C7 to emitter follower Q4 and through C2 to emitter follower Q5. The negative output pulse at the emitter of Q4 is coupled through A236C3 back to multivibrator/integrator A206, thereby initiating another peak hold cycle. The output of Q5, however, is coupled to video buffer/peak driver amplifier A223 to discharge the "memory capacitor."

3-96. Peak Level Voltage Comparator A208. When the incoming video signal level falls by more than a preset voltage (determined by the setting of A235R4), peak level voltage comparator A208 (see figure 5-13)

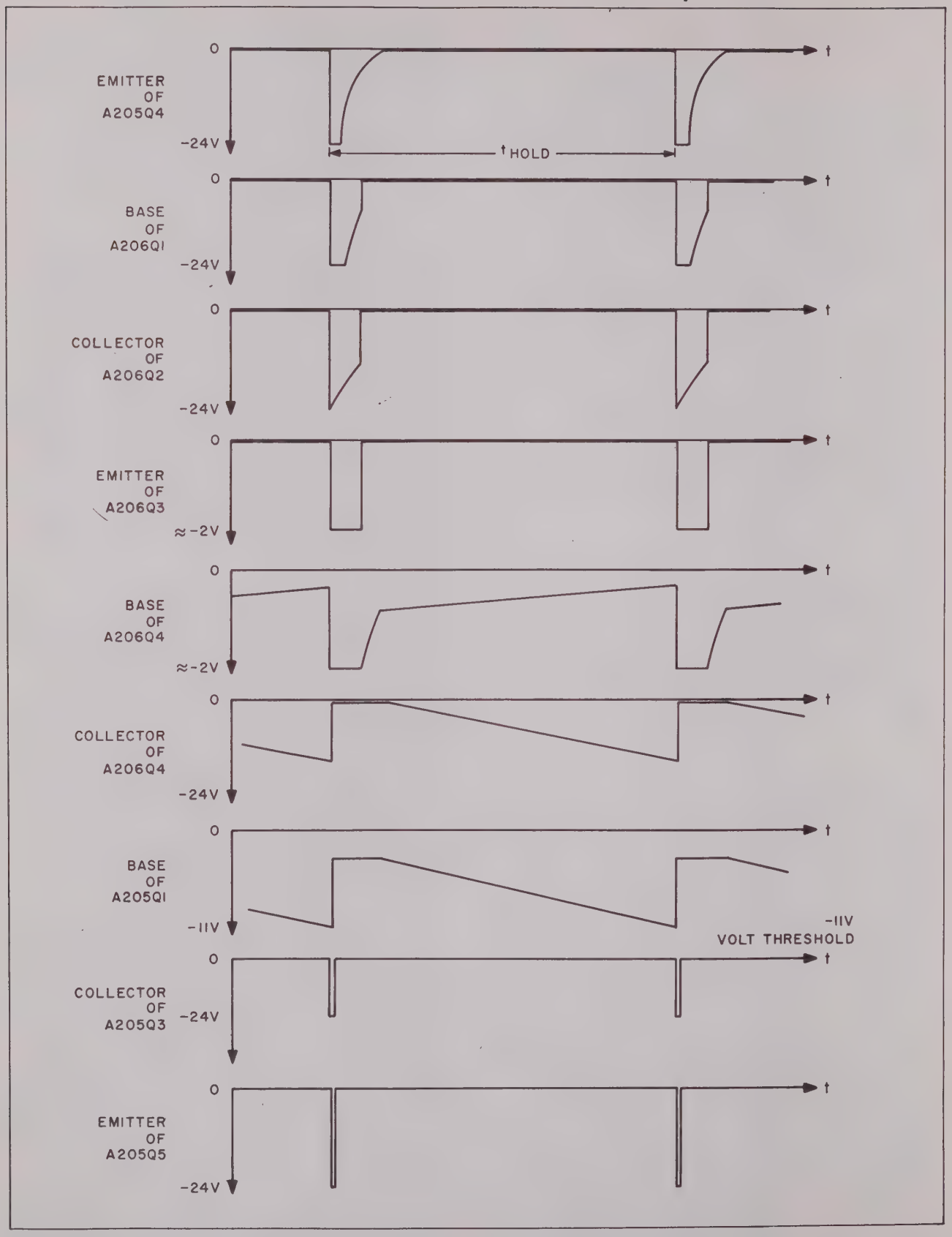


Figure 3-11. Typical Peak Hold Circuitry Waveforms

switches state and causes the collector of switch Q6, which is normally at approximately +20 volts, to drop to ground. The negative pulse created by this transition is coupled through A236C9 to pin 2 of multivibrator/integrator A206, thereby initiating a new peak hold cycle.

3-97. MEMORY CLEAR PULSE AMPLIFIER A209. Memory clear pulse amplifier A209 (see figure 5-14) is employed to discharge the "memory capacitor" during transient periods of equipment operation (see table 3-4). Positive inputs are applied to the base of emitter follower Q1, causing the emitter voltage to rise positively and drive switch Q2 into saturation. This places the collector of Q2 at ground, forward-biasing discharge diode CR6 of video buffer/peak driver amplifier A223. Note that the +27 volt input when the SWEEP START pushbutton switch is depressed (via pin 7) is coupled directly to the base of switch Q2 through steering diode CR6, thereby keeping Q2 in saturation and preventing the "memory capacitor" from charging until the switch is released.

3-98. Negative inputs are applied to the base of pulse amplifier Q3. Q3 inverts the signal and d-c couples it to emitter follower Q1. Note that the input at pin 13 is also coupled through pin 10 to scan direction control flip-flop A212 (via A236C4 and A236R6) to place the flip-flop in its "set" state.

3-99. SLIDEBACK/VIDEO STRETCH AMPLIFIER A210. Slideback/video stretch amplifier A210 (see figure 5-15) serves the dual function of allowing peak measurements of applied r-f signals by the slideback technique and streching narrow video pulses so that they may be observed on an external oscilloscope. The positive video output from complementary-symmetry amplifier Q1/Q2 of video buffer/peak driver amplifier A223 is applied to the base of Q2, part of an emitter-coupled difference amplifier. An adjustable d-c voltage, variable between 0 and approximately +7 volts as determined by the setting of SLIDEBACK THRESHOLD control R258, is simultaneously applied to the base of Q1. As long as the voltage at the base of Q2 is more positive than the voltage at the base of Q1, the voltage at the collector of d-c amplifier Q3 is sufficiently positive so as to cause emitter follower Q4 and switch Q5 to conduct. This provides a current path through SLIDEBACK INDICATOR lamp DS204 to ground (when ANALYSIS MODE switch S208 is set to SLIDEBACK), thereby illuminating the lamp. When the SLIDEBACK THRESHOLD control is adjusted so that the voltage at the base of Q1 equals that applied to the base of Q2, the voltage at the collector of Q3 drops to ground, thereby cutting off Q4. This causes Q5 to act as a high impedance which lowers the voltage drop across DS204 below the necessary sustaining value and extinguishes the lamp. When this occurs, the d-c voltage from the wiper of R258 equals the peak value of the video signal. This d-c voltage is then applied to metering operational amplifier A218 (refer to paragraph 3-101). Note that the modulation content of the applied video signal is taken at the common emitter of Q1/Q2 and coupled through AUDIO GAIN control R253 to audio amplifier A201 (refer to paragraph 3-102).

TABLE 3-4. INPUTS TO MEMORY CLEAR PULSE AMPLIFIER A209

Pin Number	Input
5	+24 volt pulse when SWEEP START pushbutton switch S209 is depressed to continue automatic continuous sector scan sweep after sweep has been interrupted by activation of signal present circuitry; +27 volt pulse upon release of the SWEEP START pushbutton switch immediately after initiation of either single or continuous sector scan sweep.
6	+27 volt pulse when bandswitching (manual, single sector scan or continuous sector scan operation).
7	+27 volts as long as the SWEEP START pushbutton switch is held depressed when initiating or continuing scan.
9	-24 volt pulse when scan low frequency limit is attained during either single or continuous sector scan operation.
10	-12 volt pulse when SWEEP REVERSE pushbutton switch S210 is depressed; -24 volt pulse when band 1 low frequency limit is attained during either single or continuous sector scan operation.
13	-24 volt pulse when scan high frequency limit is attained during either single or continuous sector scan operation; -24 volt pulse when band 4 high limit is attained during either single or continuous sector scan operation.

3-100. The video signal produced by applied pulsed r-f signals is coupled through VIDEO GAIN control R252 and biasing diode A233CR5 to emitter followers Q6 and Q7. These positive pulses are coupled through steering diode CR2 to both the base of emitter follower Q8 and an adjustable discharge peak detector consisting of R15, C3, A236C16 and VIDEO STRETCH switch S207. Thus, when S207 is set to 30 uS, the nominally 160 microsecond discharge time constant of R15, C3 and A236C16 is shortened to 30 microseconds by the inclusion of R203. Similarly, setting S207 to 800 uS inserts C206 to extend the discharge time constant to 800 microseconds. The resulting stretched video pulse is coupled through emitter follower Q8 to STRETCHED VIDEO connector J257 for application to an external oscilloscope.

3-101. METERING OPERATIONAL AMPLIFIER A218. The common line of the floating ±28.5 volt supply, the voltage at the wiper of SLIDEBACK THRESHOLD control R258 or the modulation-free video from video buffer/peak driver amplifier A223 (proportional to the peak, slideback peak and rms values of the applied r-f signal, respectively) are coupled to metering operational amplifier A218 through ANALYSIS MODE switch S208. The gain of the non-inverting amplifier is equalized by potentiometers R207 (Peak), R206 (SB) and R205 (RMS) to provide the same output level for a given input. Potentiometers R209 (Peak), R210 (SB) and R212 (RMS) are employed to compensate for d-c offset voltages. The output of the operational amplifier is simultaneously coupled to output meter M201 to furnish a visual indication of the applied signal level and to pin 1 of X-Y connector J258 where it is available (in conjunction with the x analog voltage) to drive auxiliary readout devices.

3-102. AUDIO AMPLIFIER A201. The time-varying component of the video signal is applied to audio amplifier A201 (see figure 5-10), where it is coupled through C1 to a pulse stretcher consisting of CR1, C3 and R2. The pulse stretcher permits aural recognition of pulse-modulated signals having narrow widths. The output of the pulse stretcher is coupled through emitter follower Q1 to phase splitter Q2, the latter providing equal amplitude but inverted outputs required to drive push-pull output amplifiers Q3 and Q4. The audio output is transformer coupled via T201 to PHONES jack J256 and SPEAKER jack J255, where it is made available for monitoring through a 600-ohm headset or a 4-ohm speaker, respectively. Note that the outpt level of the amplifier is adjustable by means of AUDIO GAIN control R253.

3-103. POWER DISTRIBUTION.

3-104. The voltages required to operate the EMA-910, as well as optionally available accessories such as the Model 3100 Digital Display Unit and the Model 8010 Ten Channel Call-up Unit, are developed by self-contained power supplies within the Data Evaluation Unit. The operation of these supplies are described in paragraphs 3-105 through 3-111.

3-105. LINE VOLTAGE SWITCHING. The capability of the EMA-910 of operating from either 115 or 230 volt a-c lines is achieved by employing power transformers having dual primary windings. When the EMA-910 is to be powered from a 115 volt line, 115V-230V switch S302 is set to 115V and the dual primary windings of both T301 and T302 are placed in parallel. Conversely, when the equipment is to operate from a 230 volt line, setting S302 to 230V places the dual windings of each transformer in series.

3-106. +12/+24 VOLT SUPPLIES. The +12 and +24 volt supplies consist of series regulators A230Q1 and A230Q2 and two interdependent conventional series regulators (A202). The output of the +12 volt supply is set by A202R8 while that of the +24 volt supply is set by A202R5.

3-107. -12/-24 VOLT SUPPLIES. The -12 and -24 volt supplies consist of series regulators A230Q3 and A230Q4 and two conventional interdependent voltage regulators (A203). The output level of the -12 volt supply is set by A203R6 while that of the -24 volt supply is set by A203R9.

3-108. +27 VOLT SUPPLY. The +27 volt supply consists of series regulators A229Q5 through A229Q7 and voltage regulator A204. The output level of this supply is set by A204R7.

3-109. FLOATING ±28.5 VOLT SUPPLIES. Floating ±28.5 volts is obtained from series regulators A230Q5 and A230Q6 in conjunction with series regulators of A207. The output level of the floating +28.5 volt supply is set by A207R14 while that for the -28.5 volt supply is set by A207R17.

3-110. HIGH VOLTAGE POWER SUPPLY. Operating voltages for the reflex klystrons is obtained from a d-c to a-c converter (Q401, Q402 and associated circuitry) driven by the +27 volt supply. The 1300 Hz square wave outputs of T401 are rectified and filtered to provide outputs of -650 and -1610 volts.

3-111. 115-VOLT 400 HZ SUPPLY. A low frequency (nominally 400 Hz) d-c to a-c converter (Q403 and Q404), driven from the +27 volt supply, furnishes a 115 volt square wave voltage necessary to drive the servomotors and afc choppers.

SECTION IV
MAINTENANCE

4-1. GENERAL.

4-2. This section contains maintenance, alignment and calibration instructions for the EMA-910. Included are a list of test equipment necessary to maintain the equipment, minimum performance standards checks to evaluate if the equipment operates within the specifications listed in paragraph 1-34, symptomatic and systematic troubleshooting procedures to localize a malfunction to an individual circuit or subassembly and alignment and calibration procedures necessary to restore the EMA-910 to proper operating condition after the required repairs and/or replacements have been effected.

4-3. REQUIRED TEST EQUIPMENT.

4-4. The test equipment required for the maintenance of the EMA-910 is listed in table 4-1. Equipment having equivalent characteristics may be substituted for those specified.

TABLE 4-1. REQUIRED TEST EQUIPMENT

Manufacturer and Model
Hewlett-Packard 354A Attenuator
Hewlett-Packard 355D Attenuator
Narda 757B-6 Attenuator
Hewlett-Packard 5245L/5253B Counter
Hewlett-Packard 3440A/3441A Digital Voltmeter
EMC 80362-Series Extender Boards
Hewlett-Packard 175A Oscilloscope
Hewlett-Packard 536A Frequency Meter
FXR N414A Frequency Meter
Wavetek 110 Function Generator
Polarad 1001 Modulator
Hewlett-Packard 428B Milliammeter
Hewlett-Packard 130C Oscilloscope
Hewlett-Packard 431C Power Meter
Hewlett-Packard 428A-21A Probe
Hewlett-Packard 608C Signal Generator
Hewlett-Packard 614A Signal Generator
Hewlett-Packard 616B Signal Generator
Hewlett-Packard 618B Signal Generator

TABLE 4-1. REQUIRED TEST EQUIPMENT (Cont'd)

Manufacturer and Model
Hewlett-Packard 620A Signal Generator
Polarad 1108 Signal Generator
Panoramic SPA-100 Spectrum Analyzer
Hewlett-Packard 8690A/8691B/8692B/8693B/8694B Sweep Oscillators
Telonic SM2000/SH-1 Sweep Oscillator
Hewlett-Packard 478A Thermistor Mount
Fluke 80B5 Voltbox
Simpson 260 Volt-Ohm-Milliammeter
Hewlett-Packard 410C Vtvm

4-5. MINIMUM PERFORMANCE STANDARDS CHECKS.

4-6. The minimum performance standards checks of table 4-3 is a systematic procedure for determining if the EMA-910 is operating within the specifications of paragraph 1-35. Set the front panel controls as listed in table 4-2 prior to initiating the checks.

TABLE 4-2. INITIAL CONTROL SETTINGS FOR MINIMUM PERFORMANCE STANDARDS CHECKS

Control	Setting
Power switch	OFF
BAND SWITCH switch	BAND 1
Band 1 tuning control	To obtain BAND 1 1-2.5 GHz indicator reading of 1.00
BANDWIDTH switch	1 MHZ
ANALYSIS MODE switch	PEAK
PEAK HOLD switch	.01 SEC
PEAK HOLD control	Fully clockwise (CAL)
METER RESPONSE switch	ZERO
MULTIPLIER switch	X10^{0} +0 DB
IF GAIN control	Mid-range
AFC switch	OFF
SWEEP MODE switch	MANUAL
SIGNAL THRESHOLD control	Fully clockwise
VIDEO GAIN control	Fully clockwise

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS

Step	Purpose	Procedure	Acceptable Indication
1	To evaluate mechanical zero setting of output meter pointer.	With the EMA-910 removed from line power, observe the output meter pointer; it should deflect to a DB ABOVE 1 MICROVOLT scale indication of 0. Adjust the output meter mechanical zero screwdriver control, if necessary, to obtain the proper deflection.	Output meter pointer deflects to a DB ABOVE 1 MICROVOLT scale indication of 0. Proceed to step 2.
2	To evaluate operating readiness.	Interconnect the equipment and apply line power as directed in steps b through d of paragraph 2-15. Set the power switch to ON and observe both the POWER ON and READY indicator lamps.	POWER ON indicator lamp illuminates when power switch is set to ON; READY indicator lamp illuminates approximately 60 seconds later. Proceed to step 3.
3	To evaluate electrical zero setting of output meter pointer.	Observe the output meter pointer; it should deflect to a DB ABOVE 1 MICROVOLT scale indication of 0. Adjust the METER ZERO screwdriver control, if necessary, to obtain the proper deflection.	Output meter pointer deflects to a DB ABOVE 1 MICROVOLT scale indication of 0. Proceed to step 4.
4	To evaluate frequency range and frequency accuracy.	Set the METER RESPONSE switch to FAST and couple a microwave signal generator (adjusted for minimum output level) to the Frequency Selection Unit RF INPUT connector as illustrated in figure 4-1. With the frequency meter tuned approximately 50 MHz from the frequency to which the EMA-910 is tuned, adjust the signal generator for a cw output of approximately 50 microvolts (@ the frequency to which the EMA-910 is tuned). Carefully adjust the signal generator frequency to obtain a maximum output meter pointer deflection. Carefully tune the frequency meter to obtain the greatest dip in the output meter deflection. Note both the frequency to which the EMA-910 is tuned and the frequency meter indication. Determine the EMA-910 frequency accuracy from the equation: $\text{Frequency accuracy (\%)} = \frac{F_{\text{frequency meter}} \pm F_{\text{EMA-910}}}{F_{\text{frequency meter}}} \times 100$ where $F_{\text{frequency meter}}$ = frequency meter indication at dip and $F_{\text{EMA-910}}$ = frequency to which EMA-910 is tuned.	EMA-910 frequency accuracy is within ±0.5% at all test frequencies. Rotate each tuning control to obtain a tuner frequency indicator reading corresponding to the low end of the band, set the BAND SWITCH switch to BAND 1 and proceed to step 5.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
4 (Cont'd)		Repeat the above procedure for BAND SWITCH switch and tuning control settings listed below. BAND SWITCH switch setting / Tuning control setting BAND 1 — 1.75 GHz BAND 1 — 2.50 GHz BAND 2 — 2.20 GHz BAND 2 — 3.30 GHz BAND 2 — 4.40 GHz BAND 3 — 4.30 GHz BAND 3 — 5.80 GHz BAND 3 — 7.30 GHz BAND 4 — 7.20 GHz BAND 4 — 8.35 GHz BAND 4 — 10.50 GHz	
5	To evaluate calibration curve accuracy.	Connect the signal generator to a power meter as illustrated in figure 4-2. Tune the signal generator to 1.10 GHz and adjust for a cw output level of -7 dBm (0.1 volt rms) as determined by the power meter. Set the MULTIPLIER switch to $X10^4$ +80 DB and couple the signal generator directly to the Frequency Selection Unit RF INPUT connector Adjust the tuning control to obtain a maximum on-scale output meter deflection. (If the output meter pointer deflects to an off-scale indication before reaching a maximum, rotate the IF GAIN control counterclockwise and repeat the tuning procedure.) Once a maximum on-scale output meter pointer deflection is obtained, depress the CALIBRATE pushbutton switch and, while the switch is held depressed, adjust the IF GAIN control to obtain an output meter DB ABOVE 1 MICROVOLT scale indication referenced in figure 2-4. Release	Output meter pointer deflects to a DB ABOVE 1 MICROVOLT scale indication of 20(±2) at all test frequencies. Set the BAND SWITCH switch to BAND 1, adjust the band 1 tuning control to obtain a BAND 1 1-2.5 GHz indicator reading of 1.10 and proceed to step 6.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

<table>
<tr><th>Step</th><th>Purpose</th><th>Procedure</th><th>Acceptable Indication</th></tr>
<tr><td>5
(Cont'd)</td><td></td><td>the CALIBRATE pushbutton switch and note the output meter pointer indication on the DB ABOVE 1 MICROVOLT scale.

Repeat the above procedure for test frequencies and BAND SWITCH switch settings listed below.

Test frequency — BAND SWITCH switch setting
1.75 GHz — BAND 1
2.40 GHz — BAND 1
2.50 GHz — BAND 2
3.30 GHz — BAND 2
4.30 GHz — BAND 2
4.40 GHz — BAND 3
5.80 GHz — BAND 3
7.20 GHz — BAND 3
7.30 GHz — BAND 4
8.35 GHz — BAND 4
10.40 GHz — BAND 4</td><td></td></tr>
<tr><td>6</td><td>To evaluate measurement accuracy of peak analysis mode.</td><td>Repeat the procedure of step 4 above for a signal generator frequency of 1.10 GHz. Note the output meter pointer indication on the DB ABOVE 1 MICROVOLT scale.

Note the output meter pointer DB ABOVE 1 MICROVOLT scale indications for signal generator output levels and MULTIPLIER switch settings listed below.

Signal Generator Level — MULTIPLIER Switch Setting
-27 dBm — X10^4 +80 DB
-27 dBm — X10^3 +60 DB</td><td>Output meter pointer deflects to the DB ABOVE 1 MICROVOLT scale indications listed below.

Signal Generator Level — MULTIPLIER Switch Setting — Output Meter DB ABOVE 1 MICROVOLT Scale Indication
-7 dBm — X10^4 +80 DB — 20 (±2)
-27 dBm — X10^4 +80 DB — 0 (±2)
-27 dBm — X10^3 +60 DB — 20 (±2)</td></tr>
</table>

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
6 (Cont'd)		Signal Generator Level / MULTIPLIER Switch Setting -27 dBm — $X10^2$ +40 DB -37 dBm — $X10^2$ +40 DB -47 dBm — $X10^2$ +40 DB -57 dBm — $X10^2$ +40 DB -67 dBm — $X10^2$ +40 DB -67 dBm — $X10^1$ +20 DB -67 dBm — $X10^0$ +0 DB	Signal Generator Level / MULTIPLIER Switch Setting / Output Meter DB ABOVE 1 MICROVOLT Scale Indication -27 dBm — $X10^2$ +40 DB — 40 (±2) -37 dBm — $X10^2$ +40 DB — 30 (±2) -47 dBm — $X10^2$ +40 DB — 20 (±2) -57 dBm — $X10^2$ +40 DB — 10 (±2) -67 dBm — $X10^2$ +40 DB — 0 (±2) -67 dBm — $X10^1$ +20 DB — 20 (±2) -67 dBm — $X10^0$ +0 DB — 40 (±2) Proceed to step 7.
7	To evaluate measurement accuracy of slideback analysis mode.	Set the MULTIPLIER switch to $X10^3$ +60 DB and adjust the signal generator output level at -7 dBm. With the SLIDEBACK THRESHOLD control rotated fully clockwise, set the ANALYSIS MODE switch to SLIDEBACK. Carefully rotate the SLIDEBACK THRESHOLD control counterclockwise until the SLIDEBACK INDICATOR lamp just extinguishes and note the output meter pointer DB ABOVE 1 MICROVOLT scale indication. Repeat this procedure for signal generator output levels listed below. Signal Generator Level -17 dBm -27 dBm -37 dBm -47 dBm	Output meter pointer deflects to DB ABOVE 1 MICROVOLT scale indications (at point where SLIDEBACK INDICATOR lamp just extinguishes) listed below. Signal Generator Level / Output Meter DB ABOVE 1 MICROVOLT Scale Indication -7 dBm — 40 (±2) -17 dBm — 30 (±2) -27 dBm — 20 (±2) -37 dBm — 10 (±2) -47 dBm — 0 (±2) Proceed to step 8.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

<table>
<tr><th>Step</th><th>Purpose</th><th>Procedure</th><th>Acceptable Indication</th></tr>
<tr><td>8</td><td>To evaluate measurement accuracy of rms analysis mode.</td><td>Set the signal generator output level at -7 dBm and set the ANALYSIS MODE switch to RMS. Note the output meter pointer DB ABOVE 1 MICROVOLT scale indication.

Note the output meter pointer DB ABOVE 1 MICROVOLT scale indications for signal generator output levels listed below.

Signal Generator Level

-17 dBm

-27 dBm

-37 dBm

-47 dBm</td><td>Output meter pointer deflects to DB ABOVE 1 MICROVOLT scale indications listed below.

Signal Generator Level / Output Meter DB ABOVE 1 MICROVOLT Scale Indication

-7 dBm — 40 (±2)

-17 dBm — 30 (±2)

-27 dBm — 20 (±2)

-37 dBm — 10 (±2)

-47 dBm — 0 (±2)

Set the BANDWIDTH switch to 0.5 MHZ, the ANALYSIS MODE switch to PEAK and proceed to step 9.</td></tr>
<tr><td>9</td><td>To evaluate broadband (impulse) sensitivity.</td><td>With no r-f signal applied to the EMA-910 and the band 1 tuning control adjusted to obtain a BAND 1 1-2.5 GHZ indicator reading of 1.00, set the MULTIPLIER switch to X10^0 +0 DB. Depress the CALIBRATE pushbutton switch and, while holding the switch depressed, adjust the IF GAIN control to obtain the output meter DB ABOVE 1 MICROVOLT scale indication referenced in figure 2-4. Release the CALIBRATE pushbutton switch and note the output meter DB ABOVE 1 MICROVOLT scale indication. Set the BANDWIDTH switch, in sequence, to 1 MHZ, 5 MHZ and FULL and note the output meter pointer DB ABOVE 1 MICROVOLT scale indication for each setting of the BANDWIDTH switch.

Reset the BANDWIDTH switch to 0.5 MHZ and repeat the above procedure for BAND SWITCH switch and tuning control settings listed below.

BAND SWITCH Switch Setting / Tuning Control Setting

BAND 1 — 1.75 GHz

BAND 1 — 2.50 GHz

BAND 2 — 2.40 GHz</td><td>Output meter pointer deflects to the DB ABOVE 1 MICROVOLT scale indications listed below for all test frequencies.

BANDWIDTH Switch Setting / Output Meter DB ABOVE 1 MICROVOLT Scale Indication / Broadband Sensitivity (dB above 1 uV/MHz)

0.5 MHZ — 22 or less — 28 or better

1 MHZ — 25 or less — 25 or better

5 MHZ — 32 or less — 18 or better

FULL — 35 or less — 15 or better

Set the BANDWIDTH switch to 0.5 MHZ, set the BAND SWITCH to BAND 1 adjust the Band 1 tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of 1.00 and proceed to step 10.</td></tr>
</table>

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

<table>
<tr><th>Step</th><th>Purpose</th><th>Procedure</th><th>Acceptable Indication</th></tr>
<tr><td>9
(Cont'd)</td><td></td><td>
<table>
<tr><th>BAND SWITCH
Switch Setting</th><th>Tuning
Control Setting</th></tr>
<tr><td>BAND 2</td><td>3.30 GHz</td></tr>
<tr><td>BAND 2</td><td>4.40 GHz</td></tr>
<tr><td>BAND 3</td><td>4.30 GHz</td></tr>
<tr><td>BAND 3</td><td>5.80 GHz</td></tr>
<tr><td>BAND 3</td><td>7.30 GHz</td></tr>
<tr><td>BAND 4</td><td>7.20 GHz</td></tr>
<tr><td>BAND 4</td><td>8.35 GHz</td></tr>
<tr><td>BAND 4</td><td>10.50 GHz</td></tr>
</table>
</td><td></td></tr>
<tr><td>10</td><td>To evaluate narrowband (cw) sensitivity.</td><td>With no signal applied to the EMA-910 and the ANALYSIS MODE switch set to PEAK, depress the CALIBRATE pushbutton switch and, while holding the switch depressed, adjust the IF GAIN control to obtain the output meter DB ABOVE 1 MICROVOLT scale indication referenced in figure 2-4. Release the CALIBRATE pushbutton switch and set the ANALYSIS MODE switch to RMS. Note the output meter pointer deflection on the DB ABOVE 1 MICROVOLT scale. Set the BANDWIDTH switch, in sequence, to 1 MHZ, 5 MHZ and FULL and note the output meter pointer DB ABOVE 1 MICROVOLT scale indication for each setting of the BANDWIDTH switch.

Reset the BANDWIDTH switch to 0.5 MHZ and repeat the above procedure for BAND SWITCH switch and tuning control settings listed below.
<table>
<tr><th>BAND SWITCH
Switch Setting</th><th>Tuning
Control Setting</th></tr>
<tr><td>BAND 1</td><td>1.75 GHz</td></tr>
<tr><td>BAND 1</td><td>2.50 GHz</td></tr>
<tr><td>BAND 2</td><td>2.40 GHz</td></tr>
<tr><td>BAND 2</td><td>3.30 GHz</td></tr>
<tr><td>BAND 2</td><td>4.40 GHz</td></tr>
<tr><td>BAND 3</td><td>4.30 GHz</td></tr>
</table>
</td><td>Output meter pointer deflects to the DB ABOVE 1 MICROVOLT scale indications listed below for all test frequencies.
<table>
<tr><th>BANDWIDTH
Switch
Setting</th><th>Output Meter
DB ABOVE 1
MICROVOLT
Scale Indication</th><th>Narrowband
Sensitivity
(db above
1 uV)</th></tr>
<tr><td>0.5 MHZ</td><td>7 or less</td><td>7 or better</td></tr>
<tr><td>1 MHZ</td><td>10 or less</td><td>10 or better</td></tr>
<tr><td>5 MHZ</td><td>17 or less</td><td>17 or better</td></tr>
<tr><td>FULL</td><td>20 or less</td><td>20 or better</td></tr>
</table>
Set the BANDWIDTH switch to FULL, set the BAND SWITCH switch to BAND 1, adjust the band 1 tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of 1.00, set the MULTIPLIER switch to $X10^4$ +80 DB and proceed to step 11.</td></tr>
</table>

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

<table>
<tr><th>Step</th><th>Purpose</th><th>Procedure</th><th>Acceptable Indication</th></tr>
<tr><td>10
(Cont'd)</td><td></td><td>
<table>
<tr><th>BAND SWITCH
Switch Setting</th><th>Tuning
Control Setting</th></tr>
<tr><td>BAND 3</td><td>5.80 GHz</td></tr>
<tr><td>BAND 3</td><td>7.30 GHz</td></tr>
<tr><td>BAND 4</td><td>7.20 GHz</td></tr>
<tr><td>BAND 4</td><td>8.35 GHz</td></tr>
<tr><td>BAND 4</td><td>10.50 GHz</td></tr>
</table>
</td><td></td></tr>
<tr><td>11</td><td>To evaluate image rejection.</td><td>
With the MULTIPLIER switch set to X10^4 +80 DB, couple the signal generator directly to the EMA-910 RF INPUT connector. Adjust the generator for a cw output of approximately -7 dBm at the frequency to which the EMA-910 is tuned. Carefully trim the generator frequency to obtain a maximum output meter pointer deflection. Reduce the generator output level to -70 dBm, set the MULTIPLIER switch to X10^0 +0 DB and adjust the IF GAIN control to obtain an output meter -DBM scale indication of 70. Carefully tune the generator to the image frequency (1.48 GHz) and increase its output level to 0 dBm. Note the output meter pointer deflection on the -DBM scale.

Reset the BANDWIDTH switch to FULL and the MULTIPLIER switch to X10^4 +80 DB and repeat the above procedure for BAND SWITCH switch settings, tuning control settings, signal generator (image frequency) settings and levels listed below.
<table>
<tr><th>BAND SWITCH
Switch
Setting</th><th>Tuning
Control
Setting</th><th>Image
Frequency</th><th>Image
Signal
Level</th></tr>
<tr><td>BAND 1</td><td>1.75 GHz</td><td>2.23 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 1</td><td>2.50 GHz</td><td>2.98 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 2</td><td>2.40 GHz</td><td>1.92 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 2</td><td>3.40 GHz</td><td>2.92 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 2</td><td>4.40 GHz</td><td>3.92 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 3</td><td>4.30 GHz</td><td>4.78 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 3</td><td>5.80 GHz</td><td>6.28 GHz</td><td>0 dBm</td></tr>
</table>
</td><td>
Output meter pointer deflects to, or to the left of, the -DBM scale indication listed below for each test image frequency.
<table>
<tr><th>Test Image
Frequency</th><th>Output Meter -DBM
Scale Indication</th></tr>
<tr><td>2.23 GHz</td><td>70</td></tr>
<tr><td>2.98 GHz</td><td>70</td></tr>
<tr><td>1.92 GHz</td><td>70</td></tr>
<tr><td>2.92 GHz</td><td>70</td></tr>
<tr><td>3.92 GHz</td><td>70</td></tr>
<tr><td>4.78 GHz</td><td>70</td></tr>
<tr><td>6.28 GHz</td><td>70</td></tr>
<tr><td>7.78 GHz</td><td>70</td></tr>
<tr><td>6.74 GHz</td><td>70</td></tr>
<tr><td>8.06 GHz</td><td>70</td></tr>
<tr><td>8.26 GHz</td><td>65</td></tr>
<tr><td>10.02 GHz</td><td>65</td></tr>
</table>
</td></tr>
</table>

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

<table>
<tr><th>Step</th><th>Purpose</th><th>Procedure</th><th>Acceptable Indication</th></tr>
<tr><td>11
(Cont'd)</td><td></td><td>
<table>
<tr><th>BAND SWITCH Switch Setting</th><th>Tuning Control Setting</th><th>Image Frequency</th><th>Image Signal Level</th></tr>
<tr><td>BAND 3</td><td>7.30 GHz</td><td>7.78 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 4</td><td>7.20 GHz</td><td>6.74 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 4</td><td>8.50 GHz</td><td>8.06 GHz</td><td>0 dBm</td></tr>
<tr><td>BAND 4</td><td>8.70 GHz</td><td>8.26 GHz</td><td>-5 dBm</td></tr>
<tr><td>BAND 4</td><td>10.50 GHz</td><td>10.02 GHz</td><td>-5 dBm</td></tr>
</table>
</td><td>Set the BAND SWITCH switch to BAND 1, rotate the band 1 tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of 1.00, set the MULTIPLIER switch to $X10^4$ +80 DB and proceed to step 12.</td></tr>
<tr><td>12</td><td>To evaluate spurious response rejection.</td><td>With the MULTIPLIER switch set to $X10^4$ +80 DB, adjust the signal generator for a cw output of approximately -7 dBm at the frequency to which the EMA-910 is tuned. Carefully trim the generator frequency to obtain a maximum output meter pointer deflection. Reduce the generator output level to -85 dBm, set the MULTIPLIER switch to $X10^0$ +0 DB and adjust the IF GAIN control to obtain an output meter pointer deflection of 85 on the -DBM scale. Adjust the generator frequency to a spurious response of 1.12 GHz (while setting its output level at 0 dBm) and note the output meter pointer deflection on the -DBM scale.

Repeat the above procedure for BAND SWITCH switch settings, tuning control settings, spurious response frequencies and spurious signal levels listed below.
<table>
<tr><th>BAND SWITCH Switch Setting</th><th>Tuning Control Setting</th><th>Spurious Response Frequency</th><th>Spurious Signal Level</th></tr>
<tr><td>BAND 1</td><td>1.00 GHz</td><td>1.36 GHz</td><td>0 dBm</td></tr>
<tr><td>↑</td><td>1.00 GHz</td><td>2.24 GHz</td><td>↑</td></tr>
<tr><td>↕</td><td>1.00 GHz</td><td>2.72 GHz</td><td>↕</td></tr>
<tr><td>↕</td><td>1.75 GHz</td><td>1.87 GHz</td><td>↕</td></tr>
<tr><td>↕</td><td>1.75 GHz</td><td>2.11 GHz</td><td>↕</td></tr>
<tr><td>BAND 1</td><td>1.75 GHz</td><td>3.74 GHz</td><td>0 dBm</td></tr>
</table>
</td><td>Output meter pointer deflects to, or to the left of, a -DBM scale indication of 85 for all spurious response frequencies.

Disconnect the signal generator from the Frequency Selection Unit RF INPUT connector, set the MULTIPLIER switch to $X10^4$ +80 DB, disconnect the i-f patch cable from the Data Evaluation Unit rear panel 240 MHZ INPUT connector and proceed to step 13.</td></tr>
</table>

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure				Acceptable Indication
		BAND SWITCH Switch Setting	Tuning Control Setting	Spurious Response Frequency	Spurious Signal Level	
12 (Cont'd)		BAND 1	1.75 GHz	4.22 GHz	0 dBm	
			2.50 GHz	2.62 GHz		
				2.86 GHz		
				5.24 GHz		
		BAND 1	2.50 GHz	5.72 GHz		
		BAND 2	2.40 GHz	2.14 GHz		
				2.38 GHz		
				4.28 GHz		
			2.40 GHz	4.76 GHz		
			3.40 GHz	3.14 GHz		
				3.38 GHz		
				6.28 GHz		
			3.40 GHz	6.76 GHz		
			4.40 GHz	4.14 GHz		
				4.38 GHz		
				8.28 GHz		
		BAND 2	4.40 GHz	8.76 GHz		
		BAND 3	4.30 GHz	4.42 GHz		
				4.66 GHz		
				8.84 GHz		
		BAND 3	4.30 GHz	9.32 GHz	0 dBm	

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure				Acceptable Indication
12 (Cont'd)		BAND SWITCH Switch Setting	Tuning Control Setting	Spurious Response Frequency	Spurious Signal Level	
		BAND 3	5.80 GHz	3.95 GHz	0 dBm	
				4.11 GHz		
				5.92 GHz		
			5.80 GHz	6.16 GHz		
			7.30 GHz	4.95 GHz		
				5.11 GHz		
				7.42 GHz		
		BAND 3	7.30 GHz	7.76 GHz		
		BAND 4	7.20 GHz	4.56 GHz		
				4.75 GHz		
				6.84 GHz		
			7.20 GHz	7.13 GHz		
			8.35 GHz	5.26 GHz		
				5.42 GHz		
				7.89 GHz		
			8.35 GHz	8.13 GHz		
			10.50 GHz	6.76 GHz		
				6.92 GHz		
				10.14 GHz		
		BAND 4	10.50 GHz	10.38 GHz	0 dBm	

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
13	To evaluate i-f bandwidth.	Tune a signal generator to 240 MHz and adjust for a cw output level of -7 dBm. Connect the equipment as illustrated in figure 4-3. Carefully trim the generator frequency (while maintaining its output level at -7 dBm) to obtain a maximum output meter pointer deflection and then adjust the IF GAIN control to obtain an output meter pointer indication of 40 on the DB ABOVE 1 MICROVOLT scale. Carefully decrease the signal generator frequency (while maintaining its output level constant at -7 dBm) to obtain an output meter pointer indication of 34 on the DB ABOVE 1 MICROVOLT scale. Note the electronic counter indication. Carefully increase the signal generator frequency above 240 MHz (while maintaining its output level constant at -7 dBm) until an output meter pointer indication of 34 on the DB ABOVE 1 MICROVOLT scale is again obtained. Note the electronic counter indication. Repeat the above procedure for BANDWIDTH switch settings of 5 MHZ, 1 MHZ and 0.5 MHZ.	The i-f bandwidth (difference between electronic counter indications) as a function of BANDWIDTH switch setting shall be as listed below. BANDWIDTH Switch Setting — I-f Bandwidth (Difference between Electronic Counter Readings) FULL — 10 MHz (nominal) 5 MHZ — 4.5 to 5.5 MHz 1 MHZ — 0.8 to 1.2 MHz 0.5 MHZ — 0.4 to 0.6 MHz Set the BANDWIDTH switch to FULL, set the MULTIPLIER switch to X10^3 +60 DB, connect the i-f patch cable to the 240 MHZ INPUT connector and proceed to step 14.
14	To evaluate sampled 240-MHz pre i-f output.	Connect the equipment as illustrated in figure 4-4a. Tune the spectrum analyzer to a center frequency of 240 MHz, set for a dispersion of 30 MHz and a linear presentation. Set the BAND SWITCH switch to BAND 1 and adjust the band 1 tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of 1.10. Adjust the signal generator for a cw output of -10 dBm at 1.10 GHz. Carefully trim the generator frequency (while maintaining its output level at -10 dBm) to obtain a maximum output meter pointer deflection. Increase the signal generator output level to -7 dBm and adjust the IF GAIN control to obtain an output meter pointer indication of 40 on the DB ABOVE 1 MICROVOLT scale. Adjust the spectrum analyzer gain control to obtain a full-scale lin display. Carefully decrease the signal generator frequency (while maintaining its output level at -7 dBm) to obtain a spectrum analyzer pip display of 0.7 lin. Determine the signal generator frequency by means of the spectrum analyzer markers. Carefully increase the signal generator frequency above 240 MHz (while maintaining its output level at -7 dBm) until a spectrum analyzer pip display of 0.7 lin is again obtained. Determine the signal generator frequency by means of the spectrum analyzer markers. Connect the	The sampled 240-MHz pre i-f output level (corresponding to a full-scale output meter pointer indication with the equipment calibrated) shall be nominally 100 microvolts rms. The bandwidth of the pre i-f output shall be nominally 20 MHz. Proceed to step 15.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
14 (Cont'd)		equipment as illustrated in figure 4-4b and tune the signal generator to 240 MHz. Adjust its output level to obtain a full-scale lin display on the spectrum analyzer. Note the signal generator output level.	
15	To evaluate sampled 60-MHz post i-f output.	Connect the equipment as illustrated in figure 4-4a, coupling the spectrum analyzer to the 60 MHZ connector instead of the 240 MHZ connector. Tune the spectrum analyzer to a center frequency of 60 MHz. With the BAND SWITCH switch set to BAND 1 and the band 1 tuning control adjusted to obtain a BAND 1 1-2.5 GHZ indicator reading of 1.10, adjust the signal generator for a cw output of -7 dBm at 1.10 GHz. Carefully trim the signal generator frequency (while maintaining its output level at -7 dBm) to obtain a maximum output meter pointer deflection. Increase the signal generator output level to -7 dBm and adjust the IF GAIN control to obtain an output meter pointer indication of 40 on the DB ABOVE 1 MICROVOLT scale. Adjust the spectrum analyzer gain control to obtain a full-scale lin display. Connect the equipment as illustrated in figure 4-4b and tune the signal generator to 60 MHz. Adjust its output level to obtain a full-scale lin display on the spectrum analyzer. Note the signal generator output level.	The sampled 60-MHz post i-f output level (corresponding to a full-scale output meter pointer indication with the equipment calibrated) shall be nominally 10 millivolts rms. Proceed to step 16.
16	To evaluate operation of automatic frequency control (afc) capability.	Connect an HP 616B signal generator (tuned to 2.10 GHz and adjusted for a cw output level of -7 dBm) directly to the Frequency Selection Unit RF INPUT connector. Adjust the band 1 tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of 2.10 and then carefully trim to obtain a maximum output meter pointer deflection (adjusting the IF GAIN control, if necessary, to maintain an on-scale indication). Adjust the IF GAIN control to obtain an output meter pointer indication of 35 on the DB ABOVE 1 MICROVOLT scale. Set the AFC switch to ON and rotate the SIGNAL THRESHOLD control fully counterclockwise; note that the SIGNAL PRESENT indicator lamp illuminates. Slowly reduce the signal generator frequency to 2.00 GHz and observe the output meter and BAND 1 1-2.5 GHZ indicator readings. Slowly increase the signal generator frequency until the band 1 upper limit frequency of 2.5 GHz is reached and observe the output meter and BAND 1 1-2.5 GHZ indicator readings as the applied signal frequency is varied. Slowly increase the signal generator frequency beyond the band 1	Automatic frequency control capability shall enable the equipment to track the applied signal as it is varied within the limits of any single tuning band. The automatic frequency control capability shall become inoperative when the applied signal exceeds the frequency limits of the applicable tuner band. Set the AFC switch to OFF and proceed to step 17.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
16 (Cont'd)		upper limit frequency of 2.5 GHz and observe the output meter and BAND 1 1-2.5 GHZ indicator readings.	
17	To evaluate peak hold operation.	Connect the equipment as illustrated in figure 4-5. Tune the signal generator to 2.10 GHz and adjust for a cw output of -7 dBm. Adjust the band 1 tuning control to obtain a maximum output meter pointer deflection. Adjust the oscilloscope for externally triggered sweep and a sweep rate of 0.1 milliseconds/centimeter. Adjust the signal generator for internal pulse modulation with a pulse width of 10 microseconds, a pulse repetition rate of 500 pps and a delay of 100 microseconds. Set the ANALYSIS MODE switch to PEAK and observe the oscilloscope display. Set the oscilloscope sweep rate to 1 millisecond/centimeter and adjust the signal generator pulse repetition rate to 50 pps. Set the PEAK HOLD switch to 0.1 SEC and again observe the oscilloscope display. Adjust the signal generator for a cw output and set the PEAK HOLD switch to 0.5 SEC. Rotate the PEAK HOLD control fully clockwise to CAL. Set the signal generator modulation selector switch to "off" and note the time interval before the output meter pointer drops down scale. Adjust the signal generator for a cw output and set the PEAK HOLD switch to 5 SEC. Set the signal generator modulation selector switch to "off" and again note the time interval before the output meter pointer drops down scale.	Pulse displayed on oscilloscope is nominally 0.5 milliseconds wide when signal generator repetition rate is 500 pps, the oscilloscope sweep rate is 0.1 milliseconds/centimeter and the PEAK HOLD switch is set to .01 SEC. Pulse displayed on oscilloscope is nominally 5 milliseconds wide when signal generator repetition rate is 50 pps, the oscilloscope sweep rate is 1 millisecond/centimeter and the PEAK HOLD switch is set to 0.1 SEC. Output meter pointer maintains its deflection for 0.5 seconds (nominal) after cw signal is removed (PEAK HOLD switch set to 0.5 SEC). Output meter pointer maintains its deflection for 5 seconds (nominal) after cw signal is removed (PEAK HOLD switch set to 5 SEC). Disconnect the equipment from the setup of figure 4-5 and proceed to step 18.
18	To evaluate video output.	Connect the equipment as illustrated in figure 4-6. Set the BANDWIDTH switch to FULL and adjust the signal generator for a cw output of -7 dBm at 7.00 GHz. Set the BAND SWITCH switch to BAND 3 and adjust the band 3 tuning control to obtain a maximum output meter pointer deflection. Adjust the IF GAIN control to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale. Note the video output level. Reduce the signal generator output level to obtain an output meter indication of 0 on the DB ABOVE 1 MICROVOLT scale and again note the video output level. Increase the signal generator output level to -7 dBm. Set the modulator for a 0.2 microsecond pulse at a repetition rate of 100 pps and a delay of 2 microseconds. Adjust	Video output level varies over a 5 volt range as a function of input signal level. Video output is positive. Video output pulse shall be nominally 0.2 microseconds (corresponding to a video bandwidth of 5 MHz.

(Cont'd)

TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
18 (Cont'd)		the signal generator for external pulse modulation and note the displayed video pulse.	Proceed to step 19.
19	To evaluate stretched video output.	With the signal generator and modulator still connected to the EMA-910 as illustrated in figure 4-6, connect the oscilloscope and 50-ohm terminating resistor to the STRETCHED VIDEO connector. Adjust the modulator for a 10 microsecond pulse and set the VIDEO STRETCH switch to 30 uS. Adjust the VIDEO GAIN control to obtain a convenient oscilloscope display and note the width of the stretched pulse. Repeat the above for VIDEO STRETCH switch settings of 160 uS and 800 uS.	Video pulse stretched 30, 160 or 800 microseconds (nominal). Disconnect the equipment and proceed to step 20.
20	To evaluate fm output.	Disconnect the i-f patch cable from the Data Evaluation Unit rear panel 240 MHZ INPUT connector. Tune an HP 608C signal generator to 240 MHz and adjust for a cw output level of -25 dBm. Trim the signal generator to obtain a maximum output meter pointer deflection. Connect a vtvm to the FM connector. Adjust the signal generator frequency (while maintaining its output level constant at -25 dBm) between 235 and 245 MHz and note the vtvm indication.	FM output limits between +3 and -2 volts as a function of applied signal frequency and has a slope of 1 volt/MHz between limits. Disconnect the vtvm and proceed to step 21.
21	To evaluate audio output.	Tune the signal generator to 240 MHz and adjust for 30% amplitude modulation at 1 kHz. Connect an oscilloscope (across an 8-ohm terminating resistor) to the SPEAKER receptacle and rotate the AUDIO GAIN control fully clockwise. Note the oscilloscope display. Connect the oscilloscope (across a 600-ohm terminating resistor) to the PHONES receptacle and again note the oscilloscope display.	Waveform displayed has a peak-to-peak amplitude of 5.7 volts, nominal, corresponding to 0.5 watts into 8 ohms. Waveform displayed has a peak-to-peak amplitude of 8.5 volts, nominal, corresponding to 150 milliwatts into 600 ohms. Disconnect the signal generator and oscilloscope and proceed to step 22.
22	To evaluate analog outputs.	Connect a vtvm between pins 1 and 6 of the X-Y connector. Set the ANALYSIS MODE switch to SLIDEBACK and rotate the SLIDEBACK THRESHOLD control fully counterclockwise. Adjust the SLIDEBACK THRESHOLD control to obtain output meter pointer indications of 0, 10, 20, 30 and 40 on the DB ABOVE 1 MICROVOLT scale and, at each point, note the vtvm indication. Set the BAND SWITCH switch to BAND 1 and rotate all tuning controls fully counterclockwise. Connect the vtvm between pins 4 and 6 of the X-Y connector. Rotate the	Analog y output voltage varies from 0 to +4 volts as a function of output meter pointer deflection. Analog x voltage varies from +1.0 to +10.5 volts as a function of the frequency to which the EMA-910 is tuned.

(Cont'd)

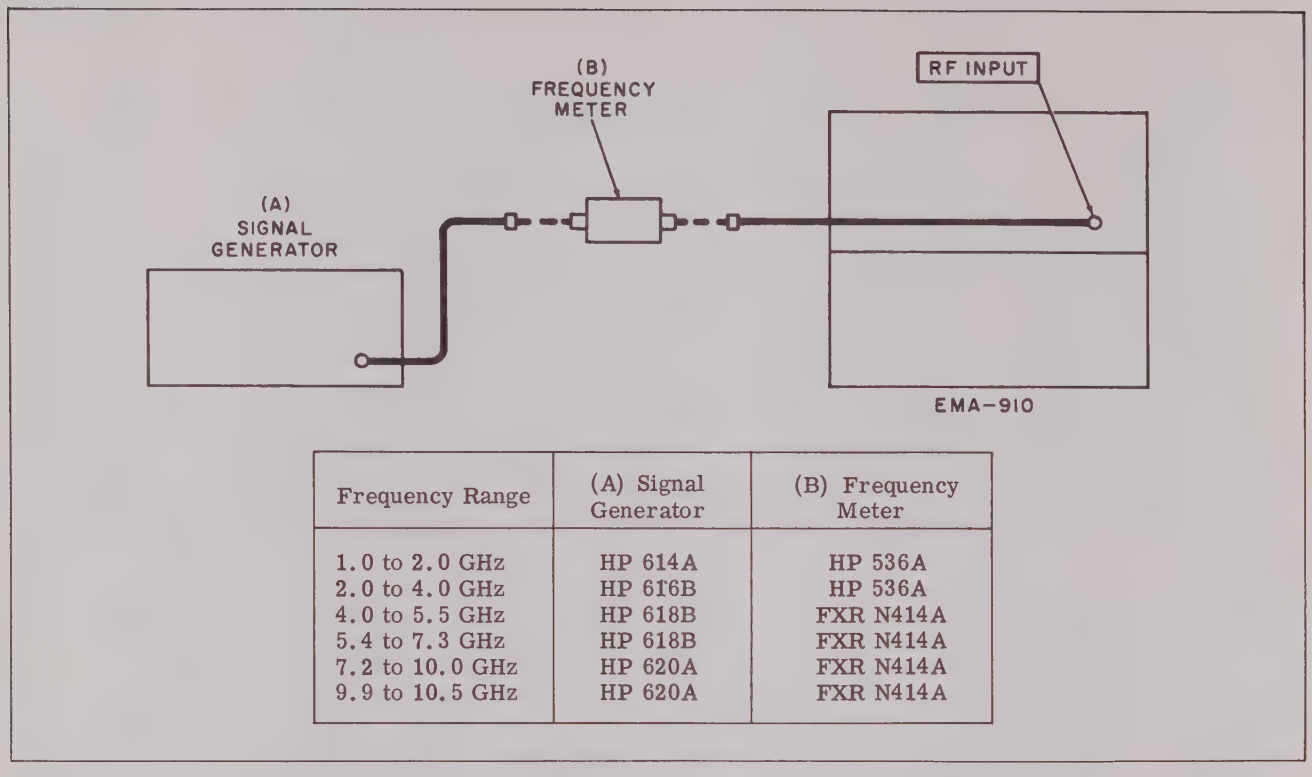
TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
22 (Cont'd)		band 1 tuning control clockwise until the band 1 high frequency limit is reached and observe the vtvm indication. Repeat the above for BAND SWITCH switch settings of BAND 2, BAND 3 and BAND 4, adjusting the appropriate tuning control until the band high limit frequency is reached.	Disconnect the vtvm and proceed to step 23.
23	To evaluate automatic scan operation.	Set the BAND SWITCH switch to BAND 1, rotate all tuning controls fully counterclockwise, set the LOWER LIMIT control to 1.00, set the UPPER LIMIT control to 10.50, set the SWEEP RATE switch to FAST and set the SWEEP RATE control fully clockwise. Set the SWEEP MODE switch to SINGLE and momentarily depress the SWEEP START pushbutton switch. Observe the operation of the single scan mode.	EMA-910 scans up frequency, at a rate of approximately 75 MHz/second, from 1.00 to 10.50 GHz, automatically band switching. When the scan upper frequency limit is reached, the scan reverses direction and scans down to the lower frequency limit, at which point it is ready for another cycle.
		Depress the SWEEP START pushbutton switch momentarily and, as the EMA-910 is scanning up frequency, rotate the SWEEP RATE control throughout its range and observe the effect on the scanning rate.	Scanning rate is continuously adjustable from 0 to 75 MHz/second.
		When the EMA-910 scan nears the upper frequency limit, reduce the sweep rate and note the effect when the upper frequency limit is reached.	Scan returns to lower limit at maximum sweep rate.
		Rotate the SWEEP RATE control fully clockwise and set the SWEEP RATE switch to SLOW. Momentarily depress the SWEEP START pushbutton switch and observe the operation of the single scan mode.	EMA-910 scans up frequency at a rate of approximately 7.5 MHz/second. When the upper limit frequency is reached, the scan reverses direction and scans down to the lower limit at maximum speed, at which point it is ready for another cycle.
		Set the SWEEP RATE switch to FAST, set the SWEEP MODE switch to SECTOR and momentarily depress the SWEEP START pushbutton switch. Observe the operation of the sector scan mode.	EMA-910 continuously scans between the upper and lower limits at the same sweep rate.
		Depress the SWEEP REVERSE pushbutton switch and observe the effect on the operation of the sector scan mode.	Scan reverses direction.
		Alternately rotate the UPPER LIMIT control counterclockwise (when the scan is near the low limit) and LOWER LIMIT control clockwise (when the scan is near	Scan width can be reduced to virtually 0 MHz. When the UPPER LIMIT control is set to a frequency below that to which the

(Cont'd)

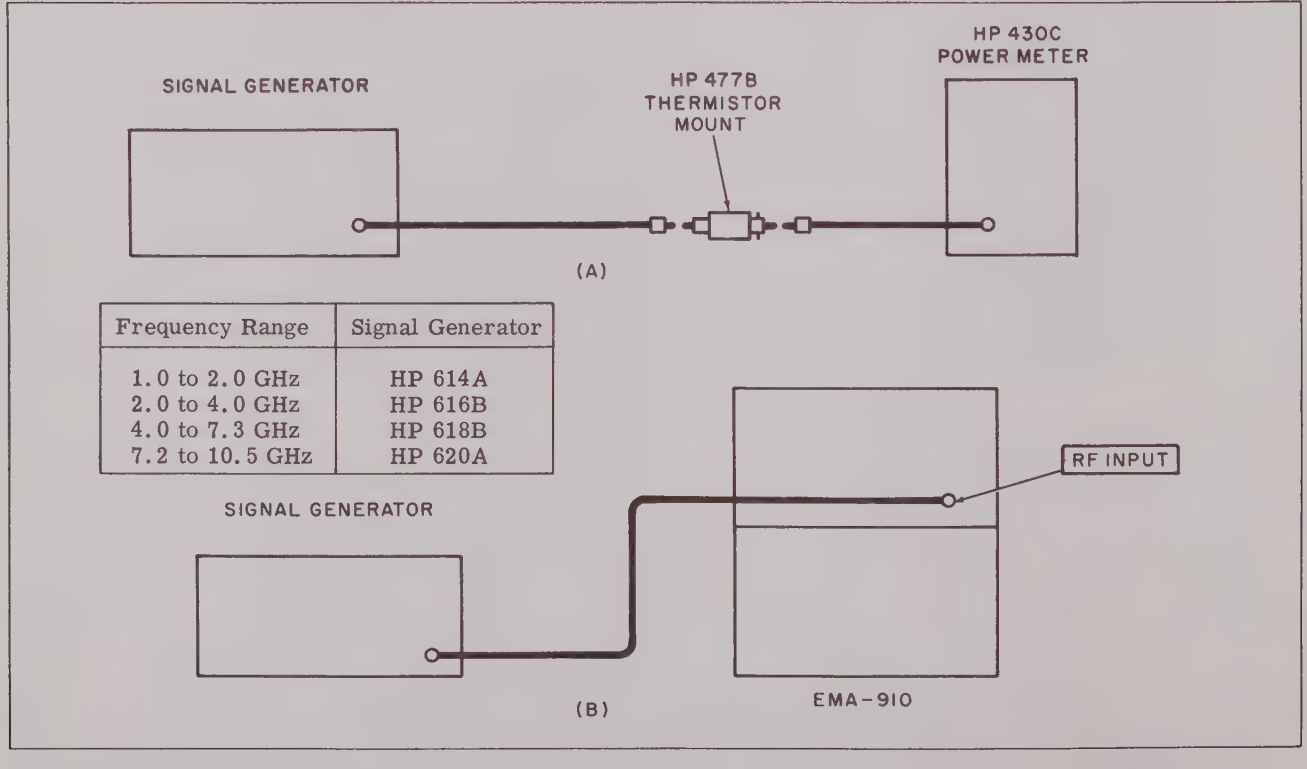
TABLE 4-3. MINIMUM PERFORMANCE STANDARDS CHECKS (Cont'd)

Step	Purpose	Procedure	Acceptable Indication
23 (Cont'd)		the high limit) and observe the effect on the operation of the sector scan mode.	LOWER LIMIT control is set, the CROSS-OVER indicator lamp will illuminate and the scan will no longer function. De-energize the EMA-910.



Frequency Range	(A) Signal Generator	(B) Frequency Meter
1.0 to 2.0 GHz	HP 614A	HP 536A
2.0 to 4.0 GHz	HP 616B	HP 536A
4.0 to 5.5 GHz	HP 618B	FXR N414A
5.4 to 7.3 GHz	HP 618B	FXR N414A
7.2 to 10.0 GHz	HP 620A	FXR N414A
9.9 to 10.5 GHz	HP 620A	FXR N414A

Figure 4-1. Minimum Performance Standards Checks Test Setup No. 1



Frequency Range	Signal Generator
1.0 to 2.0 GHz	HP 614A
2.0 to 4.0 GHz	HP 616B
4.0 to 7.3 GHz	HP 618B
7.2 to 10.5 GHz	HP 620A

Figure 4-2. Minimum Performance Standards Checks Test Setup No. 2

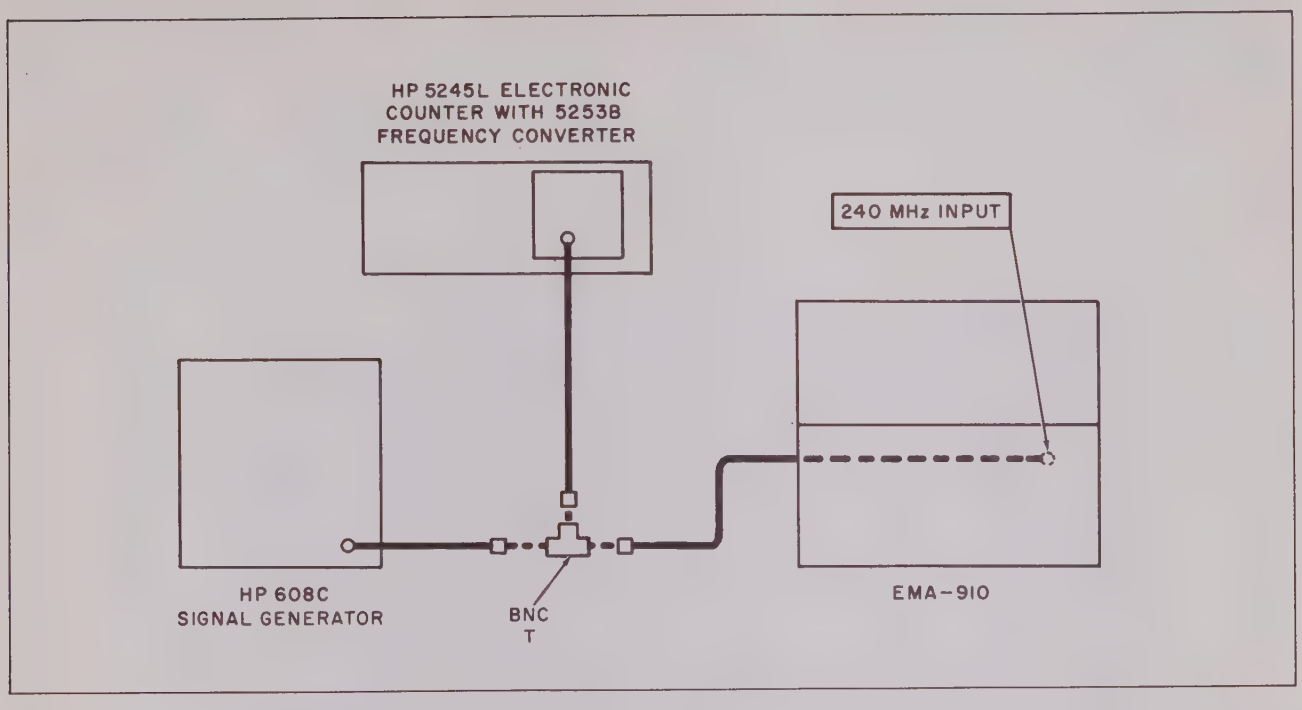


Figure 4-3. Minimum Performance Standards Checks Test Setup No. 3

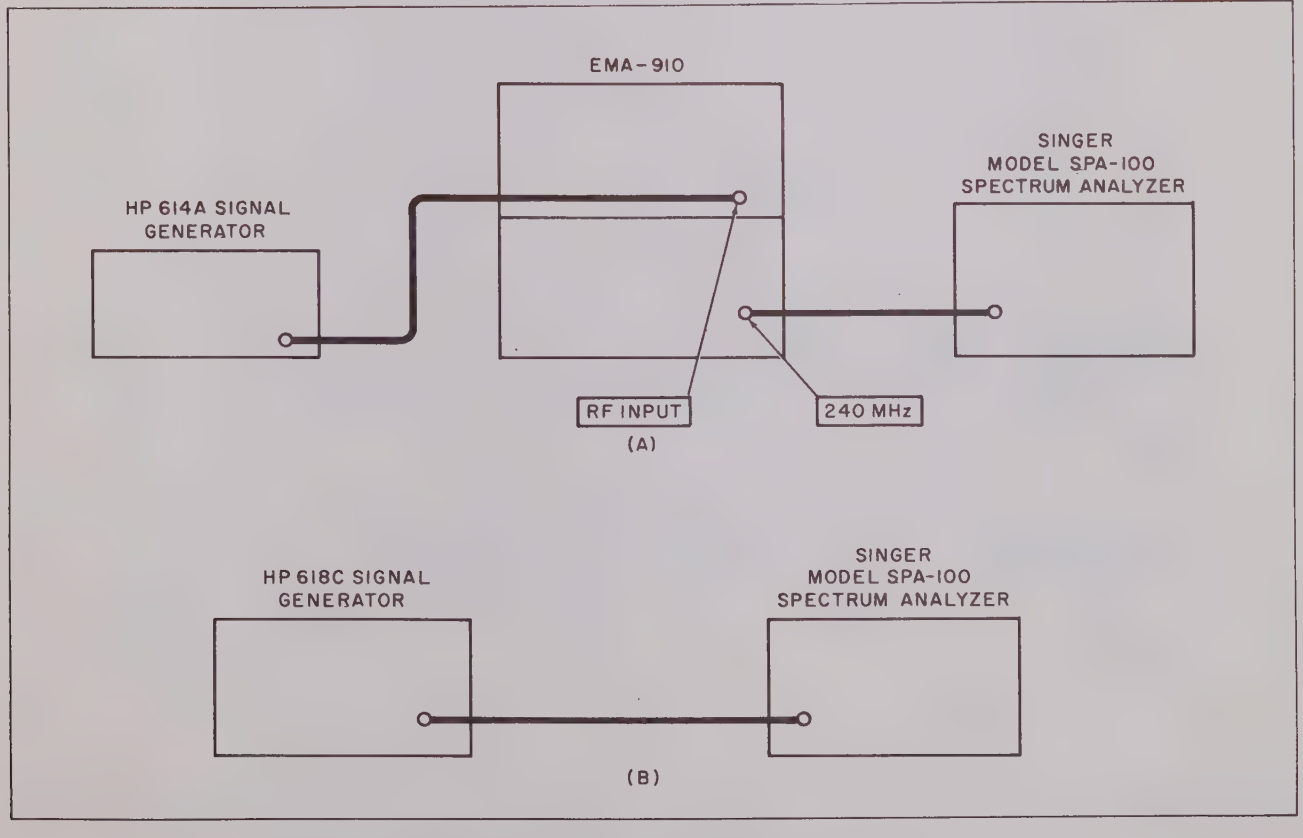


Figure 4-4. Minimum Performance Standards Checks Test Setup No. 4

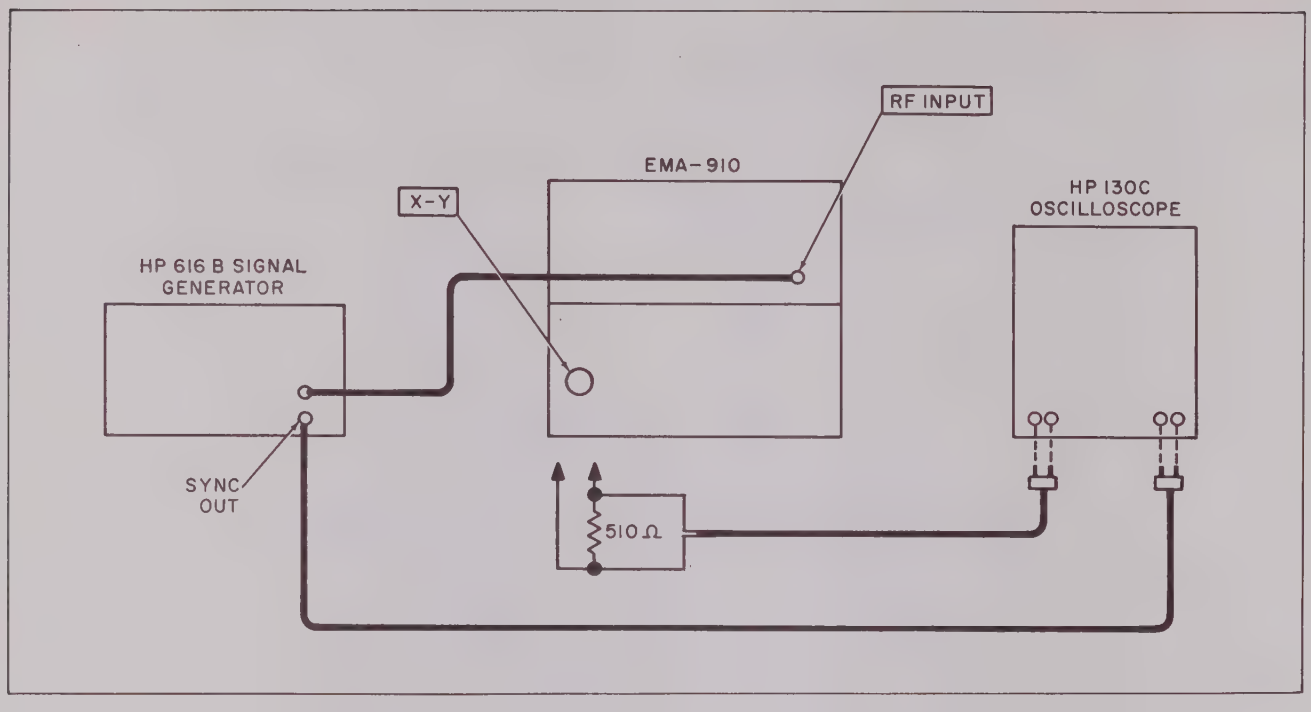


Figure 4-5. Minimum Performance Standards Checks Test Setup No. 5

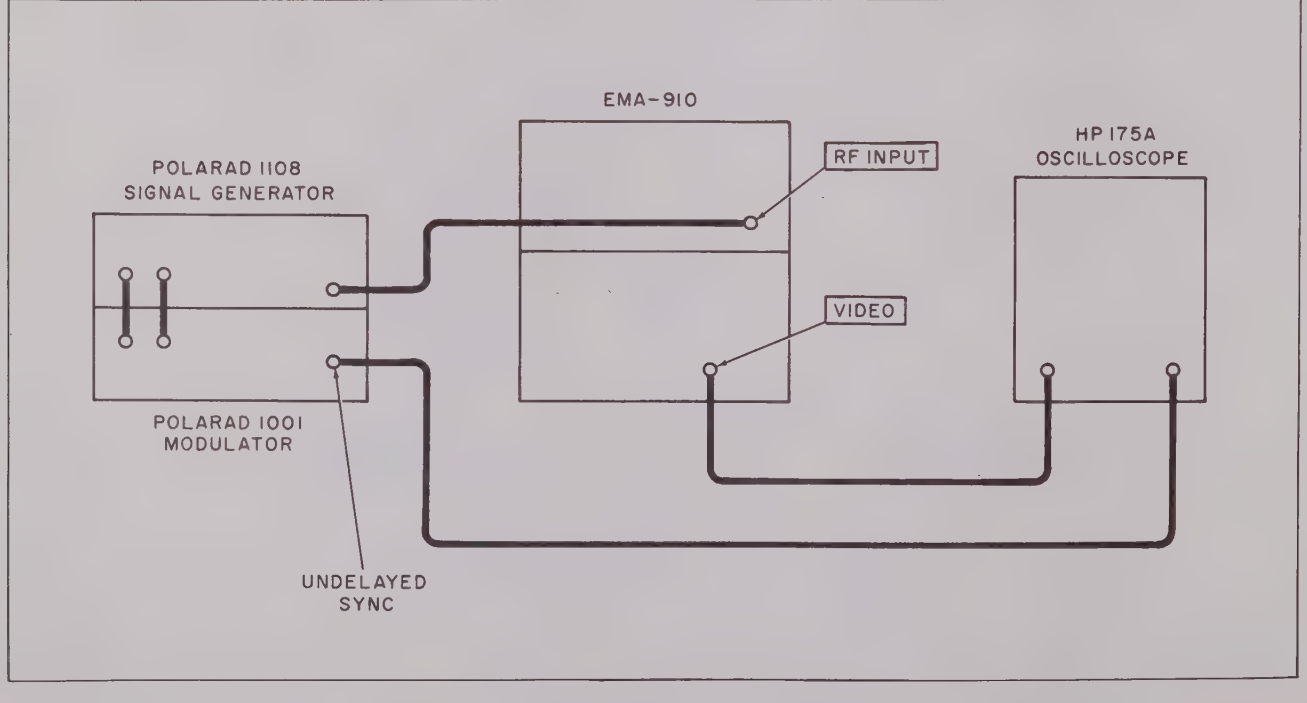


Figure 4-6. Minimum Performance Standards Checks Test Setup No. 6

4-7. COMPONENT LOCATIONS.

4-8. The location of major assemblies and subassemblies within the Data Evaluation Unit are illustrated in figures 4-7 and 4-8. Figures 4-9 and 4-10 locate the assemblies and subassemblies of the Frequency Selection Unit. To gain access to these components, remove the screws that secure the top and/or bottom cover plate from the applicable unit and remove the cover plate.

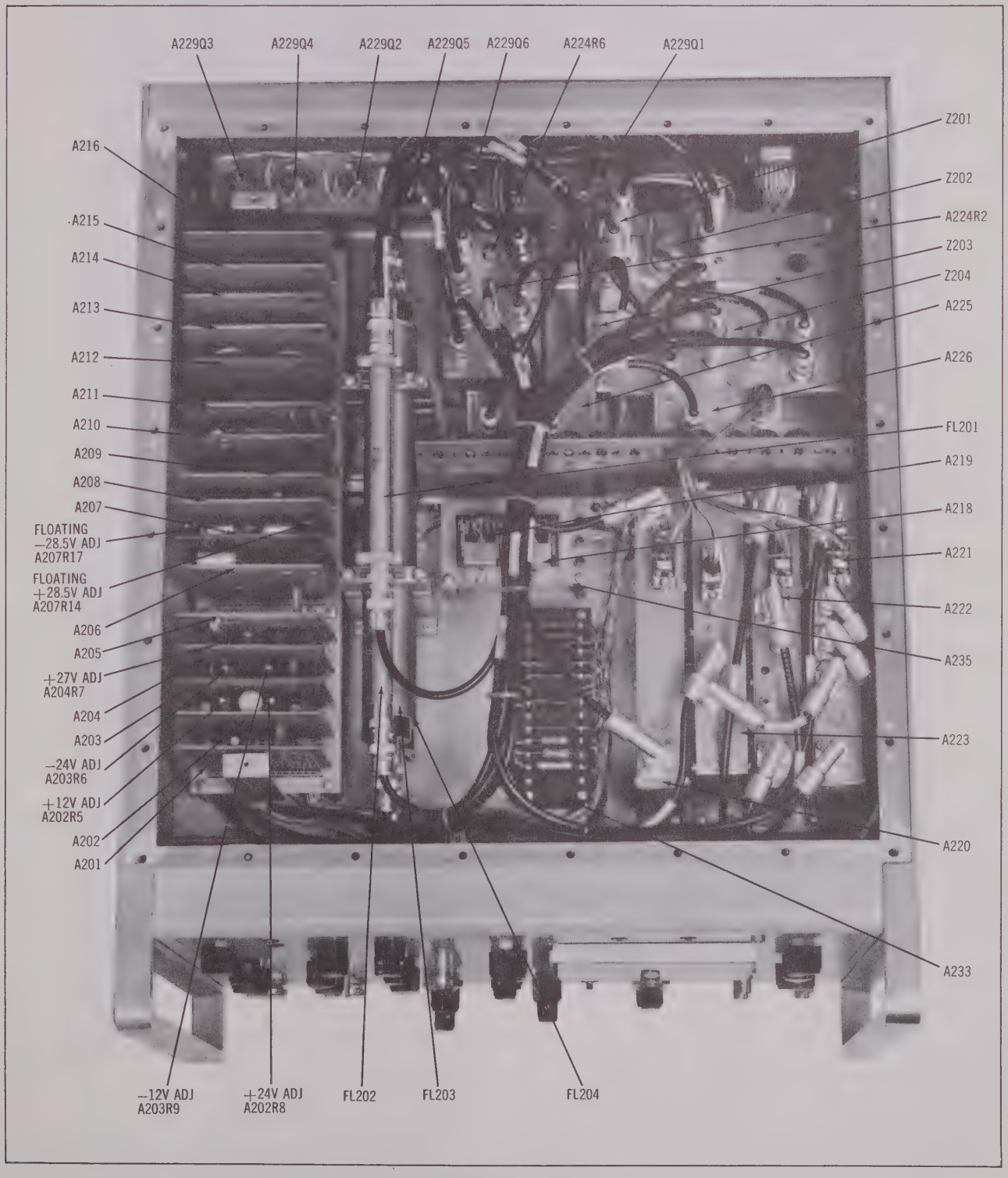


Figure 4-7. Data Evaluation Unit, Top View

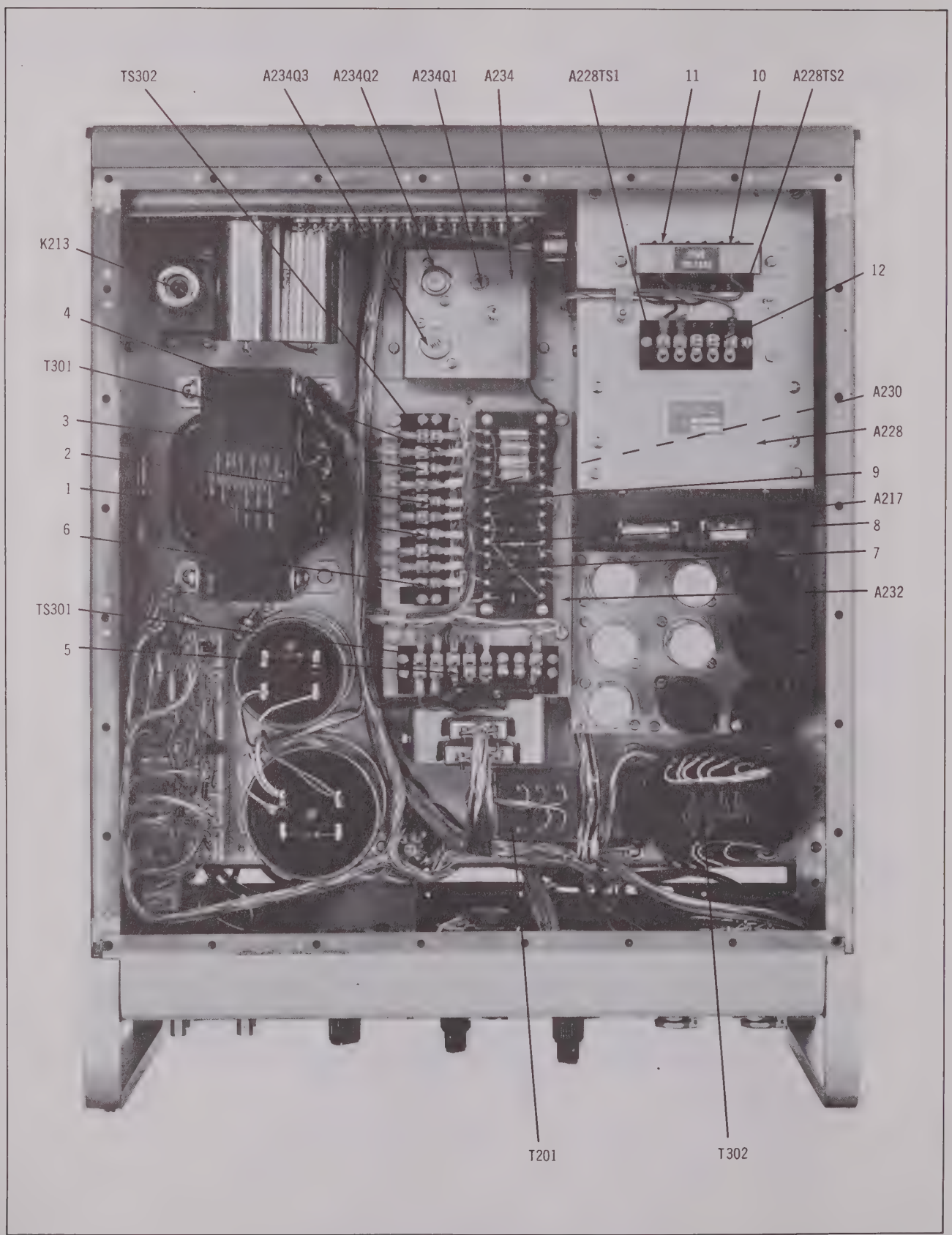


Figure 4-8. Data Evaluation Unit, Bottom View

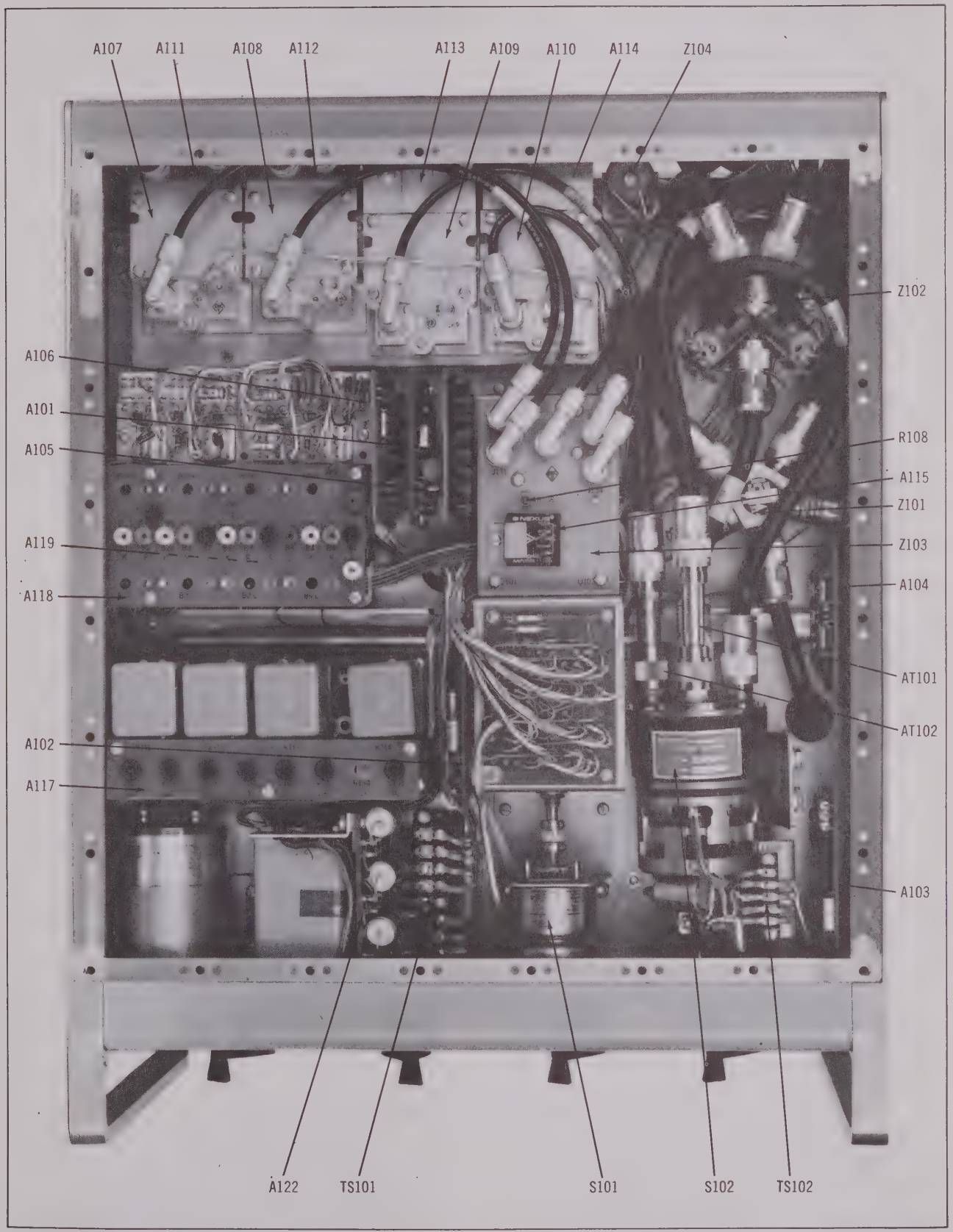


Figure 4-9. Frequency Selection Unit, Top View

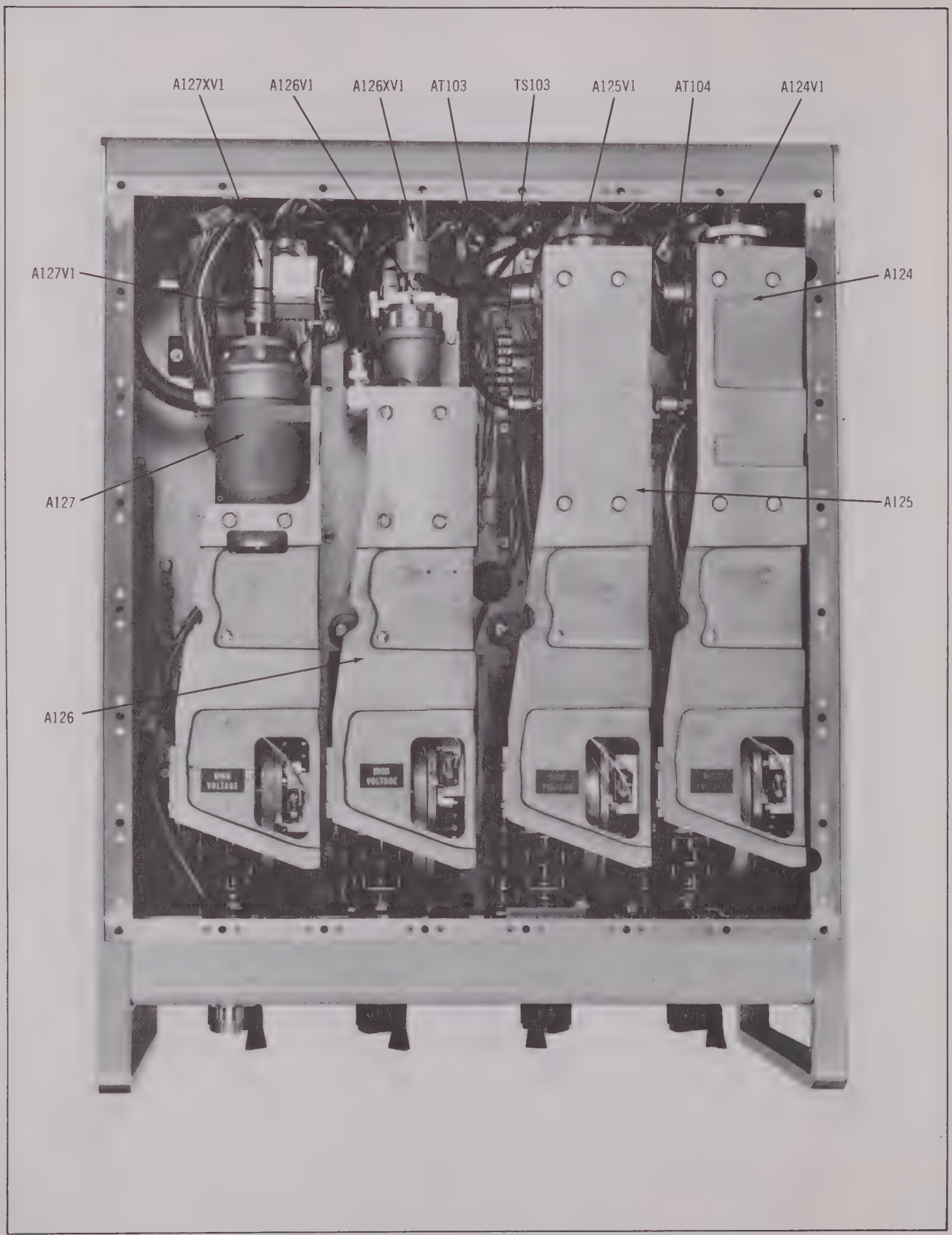


Figure 4-10. Frequency Selection Unit, Bottom View

4-9 POWER SUPPLY TROUBLE LOCALIZATION.

4-10. Improper operation of the EMA-910 may be due to a malfunction within the Data Evaluation Unit power supplies. To ascertain that these supplies are operating properly, or to localize a malfunction, proceed as directed in table 4-4. Figures 4-7 and 4-8 illustrate trouble localization test points as well as power supply adjustments.

WARNING

VOLTAGES DANGEROUS TO HUMAN LIFE EXIST AT THE PINS OF TERMINAL STRIP A228TS2. CONNECT AND/OR DISCONNECT VOLTMETER PROBES ONLY AFTER LINE POWER HAS BEEN REMOVED FROM THE DATA EVALUATION UNIT.

OBSERVE EXTREME CAUTION WHEN MEASURING BOTH LOW AND HIGH VOLTAGE POWER SUPPLY OUTPUT VOLTAGES.

4-11. LOCALIZING EQUIPMENT TROUBLE.

4-12. The selectable r-f tuning bands, analysis modes and sweep modes as well as auxiliary output functions such as video, audio, fm, etc., enables the technician to isolate a malfunction to an individual group of circuits by symptomatic troubleshooting procedures. Once the malfunction has been isolated to the particular circuit grouping, systematic trouble localization procedures will lead the technician to the defective assembly or component. Table 4-5 is a symptomatic troubleshooting guide which references the technician to the proper systematic troubleshooting, replacement and/or alignment procedure necessary to restore the equipment to normal operating condition.

4-13. R-F CIRCUITRY TROUBLESHOOTING AND ALIGNMENT PROCEDURES.

4-14. The procedures for troubleshooting and aligning the r-f circuits within the Frequency Selection Unit are contained in paragraphs 4-15 through 4-22.

Note

Should any r-f component (such as the local oscillator, preselector, impulse generator, preamplifier, etc.) require replacement and/or alignment, refer to paragraph 4-50 to obtain new calibration curves after the required maintenance procedure has been completed.

4-15. LOCAL OSCILLATOR ALIGNMENT. The procedure for aligning the band 1 and/or 2 local oscillator is detailed in paragraph 4-16; that for the band 3 and/or 4 local oscillator is contained in paragraph 4-17.

WARNING

VOLTAGES DANGEROUS TO HUMAN LIFE EXIST WITHIN THE TUNERS. OBSERVE EXTREME CAUTION WHEN MAKING ADJUSTMENTS TO ANY ENERGIZED TUNER.

4-16. Bands 1 and 2. To align the band 1 and/or band 2 local oscillator, proceed as directed in the following steps.

Note

The data contained within parenthesis applies to the band 2 local oscillator and immediately follows the equivalent information pertaining to the band 1 local oscillator.

a. With the EMA-910 unenergized and the Data Evaluation Unit coupled to the Frequency Selection Unit, remove the band 1 (band 2) tuner as detailed in paragraph 4-25.

b. Place the tuner beside the Frequency Selection Unit and connect the supplied alignment harness -- EMC Model 2008 -- between P101 (P102) and A124J1 (A125J1).

c. Connect the equipment as illustrated in figure 4-18.

d. See figure 4-19. Mount a knob on the tuning drive shaft.

e. Set the BAND SWITCH switch to BAND 1 (BAND 2), set the SWEEP MODE switch to MANUAL and energize the equipment. Allow at least 30 minutes for warmup.

f. Tune the frequency meter to a frequency below the tuner local oscillator low frequency limit of 1.24 GHz (2.16 GHz).

g. Rotate the knob to position the low frequency limit scribe mark under the index pointer.

h. See figure 4-20. Adjust B1L screwdriver control A118R1 (B2L screwdriver control A118R3) to obtain a maximum power meter indication.

i. Adjust the knob to position the high frequency limit scribe mark under the index pointer.

TABLE 4-4. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE

Step		Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
1		Connect an HP 3440A/3441A Digital Voltmeter (set to the +100 volt range) between TS302-7 (test point 1 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between +11.95 and +12.05 volts.	Proceed to major step 2.	Remove the hold-down strip that secures A201 through A216 to their mating connectors and adjust A202R5 (see figure 4-7) to obtain a voltmeter indication of +12.00 volts. If this voltage level cannot be obtained by adjustment of A202R5, proceed to minor step 1.
	1	Connect the voltmeter between T302-9 and chassis ground. Note the voltmeter indication.	Voltmeter indicates approximately +18 volts.	Proceed to minor step 2.	Proceed to major step 2.
	2	Withdraw A202 from J202 and install extender board 80632-0 into J202. Mount A202 atop the extender board and check the voltages at A202Q1 through Q4 (see figure 4-11). Check the voltages at A230Q1 by first removing the four screws (and associated hardware) that secure the mounting plate (on which A232, TS301 and TS302 are located - see figure 4-8) to the Data Evaluation Unit shelf. Remove the remaining four hexagonal spacers to gain access to A230 (see figure 4-12).	See tables 4-12 and 4-30.	- - - - - -	Locate (see figure 4-11) and replace defective components. After the necessary repairs have been effected, replace A202 and adjust A202R5 (refer to major step 1) to obtain the proper output level of +12.00 volts.
2		Connect the voltmeter between TS302-5 (test point 2 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between +23.85 and +24.15 volts.	Proceed to major step 3.	Remove the hold-down strip that secures A201 through A216 to their mating connectors and adjust A202R8 (see figure 4-7) to obtain a voltmeter indication of +24.00 volts. **Note** Due to interaction beween the +24 and +12 volt supplies, it may be necessary to repeat major steps 1 and 2 several times until the proper output voltage levels are obtained.

(Cont'd)

TABLE 4-4. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
2 (Cont'd)					If the proper output voltage level of +24.00 volts cannot be obtained by adjustment of A202R8, proceed to minor step 3.
	3	Connect a Simpson 260 VOM (set to the 50 volt a-c range) between T302-8 and T302-10. Note the vom indication.	Vom indicates approximately 29 volts rms.	Proceed to minor step 4.	Replace transformer T302.
	4	Withdraw A202 from J202 and install extender board 80362-0 into J202. Mount A202 atop the extender board and check the voltages at A202Q5 and Q6 (see figure 4-11). Check diodes A230CR9 through CR12 and the voltages at A230Q2 (refer to the procedure of minor step 2).	See tables 4-12 and 4-30.	- - - - - -	Locate (see figure 4-11) and replace defective components. After the necessary repairs have been effected, replace A202 and adjust A202R8 (refer to major step 2) to obtain the proper output level of +24.00 volts. **Note** Due to interaction between the +24 and +12 volt supplies, it may be necessary to perform the adjustments of major steps 1 and 2 several times until the proper output voltage levels are obtained.
3		Connect the voltmeter (set to the -100 volt range) between TS302-3 (test point 3 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between -11.90 and -12.10 volts.	Proceed to major step 4.	Remove the hold-down strip that secures A201 through A216 to their mating connectors and adjust A203R9 (see figure 4-7) to obtain a voltmeter indication of -12.00 volts. If this voltage level cannot be obtained by adjustment of A203R9, proceed to minor step 5.

(Cont'd)

TABLE 4-4. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
	5	Connect the voltmeter between T302-6 and chassis ground. Note the voltmeter indication.	Voltmeter indicates approximately -18 volts.	Proceed to minor step 6.	Proceed to major step 4.
	6	Withdraw A203 from J203 and install extender board 80362-1 into J203. Mount A203 atop the extender board and check the voltages at A203Q3 and Q4 (see figure 4-15.) Check the voltages at A230Q3 (refer to the procedure of minor step 2).	See tables 4-13 and 4-30.	- - - - - -	Locate (see figure 4-13) and replace defective components. After the necessary repairs have been effected, replace A203 and adjust A203R9 (refer to major step 3) to obtain the proper output level of -12.00 volts.
4		Connect the voltmeter between TS302-2 (test point 4 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between -23.85 and -24.15 volts.	Proceed to major step 5.	Remove the hold-down strip that secures A201 through A216 to their mating connectors and adjust A203R6 (see figure 4-7) to obtain a voltmeter indication of -24.00 volts. If this voltage level cannot be obtained by adjustment of A203R6, proceed to minor step 7.
	7	Connect a Simpson 260 VOM (set to the 50 volt a-c range) between T302-5 and T302-7. Note the vom indication.	Vom indicates approximately 29 volts rms.	Proceed to minor step 8.	Replace transformer T302.
	8	Withdraw A203 from J203 and insert extender board 80362-1 into J203. Mount A203 atop the extender board and check the voltages at A203Q1 and Q2 (see figure 4-13). Check the voltages at A230Q4 (refer to the procedure of minor step 2).	See tables 4-13 and 4-30.	- - - - - -	Locate (see figure 4-13) and replace defective components. After the necessary repairs have be been effected, replace A203 and adjust A203R6 (refer to major step 4) to obtain the proper output level of -24.00 volts.

(Cont'd)

TABLE 4-4. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
	8 (Cont'd)				**Note** Due to interaction between the -12 and -24 volt supplies, it may be necessary to perform the adjustments of major steps 3 and 4 several times until the proper output voltage levels are obtained.
5		Connect the voltmeter (set to the +100 volt range) between TS301-3 (test point 5 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between +26.85 and +27.15 volts	Proceed to major step 6.	Remove the hold-down strip that secures A201 through A216 to their mating connectors and adjust A204R7 (see figure 4-7) to obtain a voltmeter indication of +27.00 volts. If this voltage level cannot be obtained by adjustment of A204R7, proceed to minor step 9.
	9	Connect a Simpson 260 VOM (set to the 50 volt a-c range) between T301-5 and T301-7. Note the vom indication.	Vom indicates approximately 27 volts rms.	Proceed to minor step 10.	Replace transformer T301.
	10	Withdraw A204 from J204 and insert extender board 80362-2 into J204. Mount A204 atop the extender board and check the voltages A204Q1 through Q4 (see figure 4-14). Check diodes A230CR1 through CR4 (refer to the procedure of minor step 2). Check the voltages at A229Q5 through Q7 (see figure 4-7). Check the voltages at A234Q1 through Q3 (see figure 4-8).	See tables 4-14, 4-30 and 4-31.	- - - - - -	Locate (see figures 4-7, 4-8 and 4-14) and replace defective components. After the necessary repairs have been effected, replace A204 and adjust A204R7 (refer to major step 5) to obtain the proper output level of +27.00 volts.
6		Set the voltmeter to the +100 volt range (floating input). Remove the hold-down strip that secures A201 through A216 to their mating connectors and withdraw A207 from J207. Install extender board	Voltmeter indicates tween +28.25 and +28.75 volts.	Proceed to major step 7.	Adjust A207R14 (see figure 4-7) to obtain a voltmeter indication of +28.50 volts. If this voltage

(Cont'd)

TABLE 4-4. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
6 (Cont'd)		80362-14 into J207 and mount A207 atop the extender board. Connect the positive lead of the voltmeter to A207-11 and the common lead to A207-15. Note the voltmeter indication.			level cannot be obtained by adjustment of A207R14 proceed to minor step 11.
	11	Connect a Simpson 260 VOM (set to the 50 volt a-c range) first between T302-13 and T302-14 and then between T302-14 and T302-15. Note the vom indications.	Vom indicates approximately 27.5 volts rms.	Proceed to minor step 12.	Replace transformer T302.
	12	Check diodes A231CR2 and CR4. Check the voltages at A230Q6 (refer to the procedure of minor step 2). Check the voltages at A207Q1, Q3, Q5 and Q6 (see figure 4-15).	See tables 4-15 and 4-30.	- - - - - -	Locate (see figures 4-12 and 4-15) and replace defective components. After the necessary repairs have been effected, adjust A207R14 (refer to major step 6) to obtain the proper output level of +28.50 volts.
7		Set the voltmeter to the -100 volt range (floating input). Connect the positive lead of the voltmeter to A207-15 and the common lead to A207-13. Note the voltmeter indication.	Voltmeter indicates between -28.25 and -28.75 volts.	Proceed to major step 8.	Adjust A207R17 (see figure 4-7) to obtain a voltmeter indication of -28.50 volts. If this voltage level cannot be obtained by adjustment of A207R17, proceed to minor step 13.
	13	Check diodes A231CR1 and CR4. Check the voltages at A230Q5 (refer to the procedure of minor step 2). Check the voltages at A207Q2, Q4 and Q7 (see figure 4-15).	See tables 4-15 and 4-30.	- - - - - -	Locate (see figures 4-12 and 4-15) and replace defective components. After the necessary repairs have been effected, adjust A207R17 (refer to major step 7) to obtain the proper output level of -28.50 volts.

(Cont'd)

TABLE 4-4. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
	13 (Cont'd)				**Note** Due to interaction between the floating ±28.5 volt supplies, it will be necessary to perform the adjustments of major steps 6 and 7 several times until the proper output levels are obtained.
8		Connect the voltmeter (set to the +1000 volt range) between TS302-10 (test point 6 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between +170 and +210 volts.	Proceed to major step 9.	Proceed to minor step 14.
	14	Connect a Simpson 260 VOM (set to the 250 volt a-c range) between T302-11 and T302-12. Note the vom indication.	Vom indicates approximately 135 volts rms.	Replace A238CR1 (see figure 4-8).	Replace transformer T302.
9		Connect the voltmeter between the junction of A232CR1 and A232R2 (test point 7 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between +135 and +165 volts.	Proceed to major step 10.	Replace A232CR1 (see figure 4-8).
10		Connect the voltmeter (set to the +100 volt range) between the junction of A232CR3 and A232R4 (test point 8 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between +5.04 and +6.16 volts.	Proceed to major step 11.	Replace A232CR3 (see figure 4-8).
11		Connect the voltmeter (set to the -100 volt range) between the junction of A232CR2 and A232R3 (test point 9 in figure 4-8) and chassis ground. Note the voltmeter indication.	Voltmeter indicates between -5.04 and -6.16 volts.	Proceed to major step 12.	Replace A232CR2 (see figure 4-8).
12		Connect the voltmeter (set to the -1000 volt range) to the output of a Fluke 80B5 Voltbox. Connect the voltbox between A228TS2-5 (test point 10 in figure 4-8) and A228TS2-3. Set the BAND SWITCH switch to BAND 1 and note the voltmeter indication.	Voltmeter indicates between -63 and -67 volts (corresponding to -630 and -670 volts, respectively).	Proceed to major step 13.	Proceed to minor step 15.
	15	Check the voltages at A229Q1 and Q2 (see figure 4-7).	See table 4-29.	Replace A228T1 and/or A228BR2.	Replace A229Q1 and/or Q2.

(Cont'd)

TABLE 4-4. POWER SUPPLY TROUBLE LOCALIZATION PROCEDURE (Cont'd)

Step		Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
Major	Minor				
13		Connect the voltbox between A228TS2-1 (test point 11 in figure 4-8) and A228TS2-3. Set the BAND-SWITCH switch to BAND 3. Note the voltmeter indication.	Voltmeter indicates between -158 and -164 volts (corresponding to -1580 and -1640 volts, respectively).	Proceed to major step 14.	Replace A228T1 and/or A228BR1.
14		Connect a Simpson 260 VOM (set to the 250 volt a-c range) between A228TS1-4 (test point 12 in figure 4-8) and A228TS1-5. Note the vom indication.	Vom indicates approximately 115 volts, rms.	Power supplies are functioning properly	Proceed to minor step 16.
	16	Check the voltages at A229Q3 and Q4 (see figure 4-7). Check the voltages at A228A1Q1 through Q4 (see figures 4-16 and 4-17).	See tables 4-28 and 4-29.	Replace transformer A228T2.	Replace defective components.

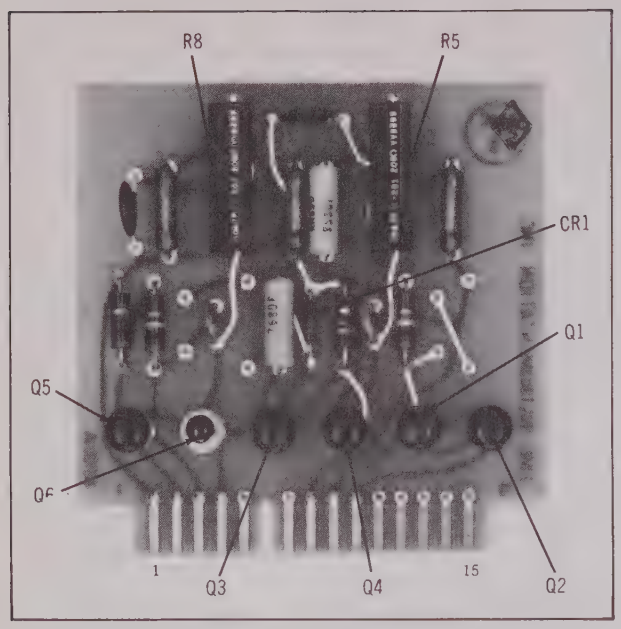


Figure 4-11. +12/+24 Volt Regulator A202

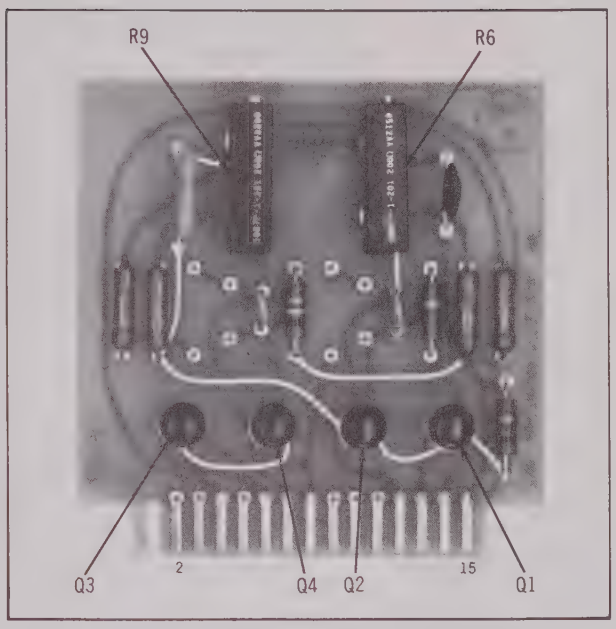


Figure 4-13. -12/-24 Volt Regulator A203

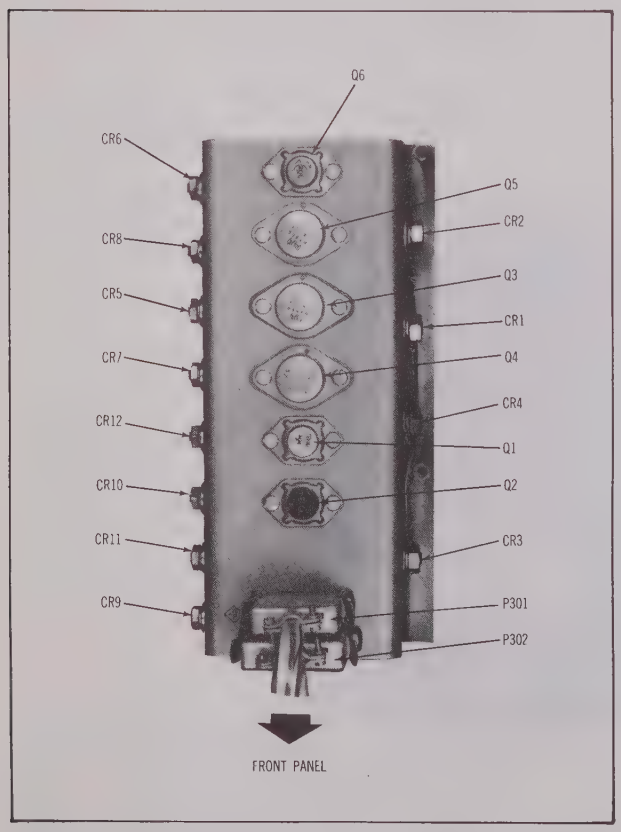


Figure 4-12. Transistor and Diode Bracket A230

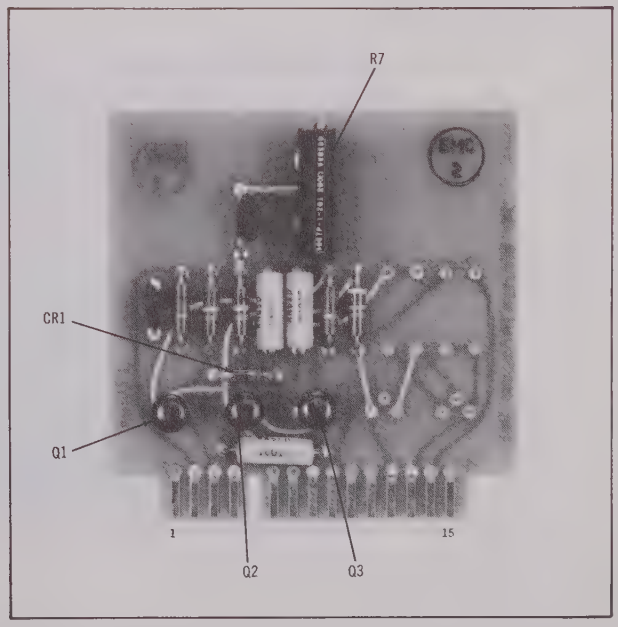


Figure 4-14. +27 Volt Regulator A204

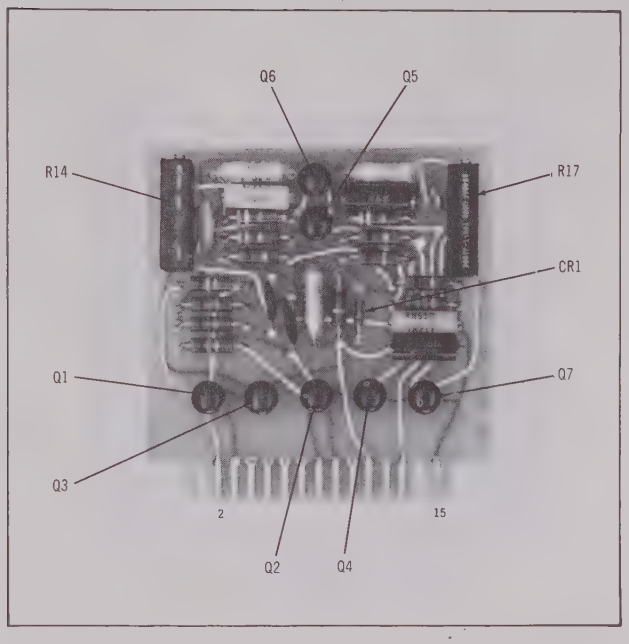


Figure 4-15. Floating ±28.5 Volt Regulator A207

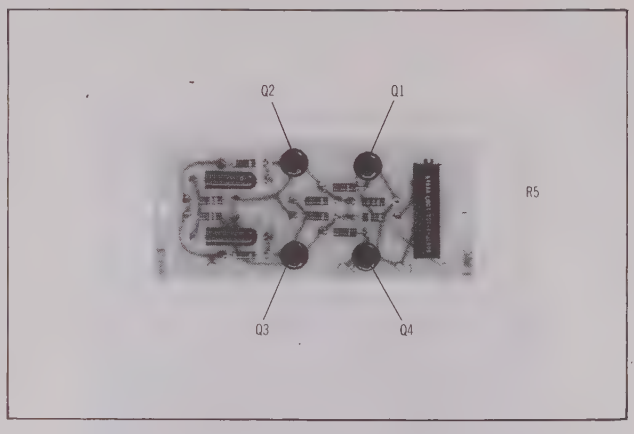


Figure 4-17. 400-Hz Oscillator A228A1

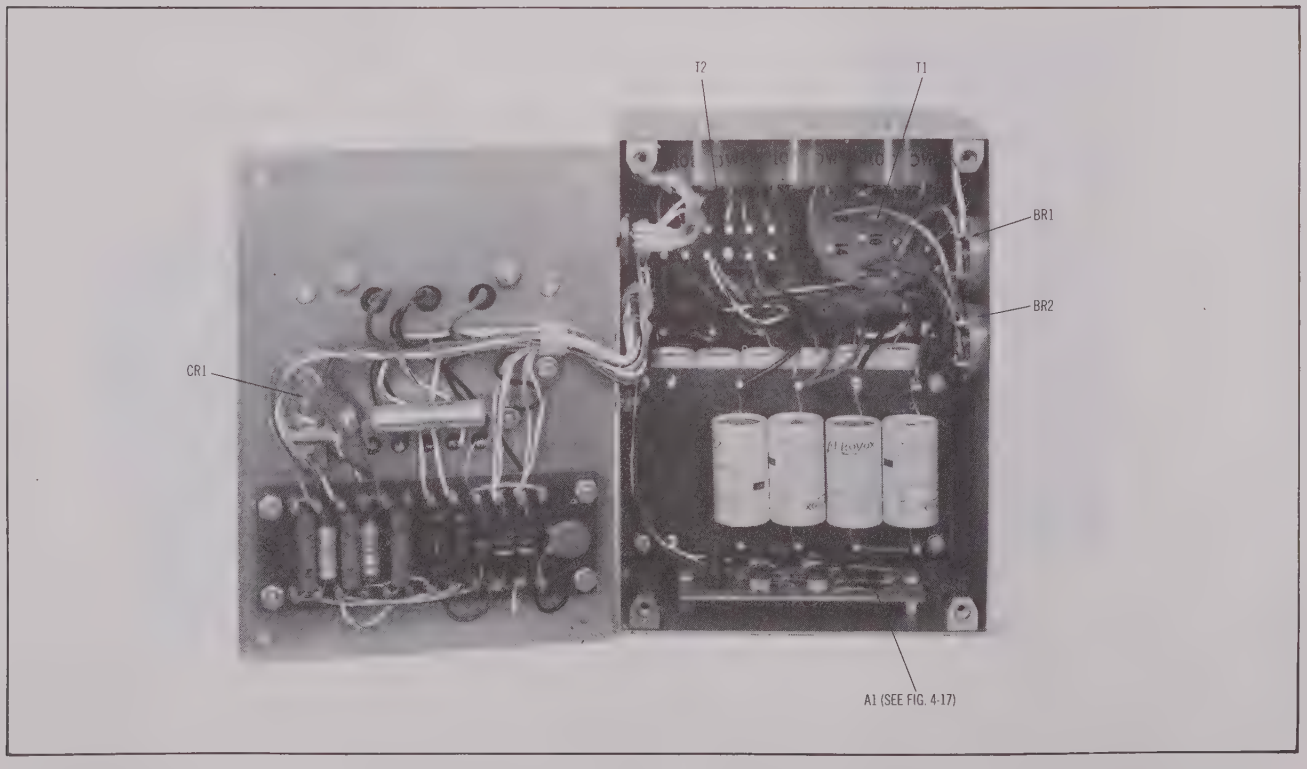


Figure 4-16. 400-Hz and High Voltage Power Supply A228

TABLE 4-5. SYMPTOMATIC TROUBLESHOOTING GUIDE

Symptom	Possible Cause
Output meter cannot be mechanically zero set.	Replace output meter.
Output meter cannot be electrically zero set.	Check S206, A218 and associated circuitry; replace any defective components.
All measurement modes inoperative and no auxiliary outputs (video, stretched video, audio, 240 MHz and 60 MHz outputs) obtainable when BAND SWITCH switch is set to a particular band; measurement modes and auxiliary outputs normal when BAND SWITCH switch is set to any of the three other tuner bands.	Check appropriate tuner as directed in table 4-6.
RMS analysis mode inoperative; slideback and peak modes operate properly.	Check S208A and associated circuitry. Check low-pass filter A223R8 and A223C8.
Slideback analysis mode inoperative; rms and peak modes operate properly.	Check S208 and associated circuitry. Check SLIDE-BACK INDICATOR DS204. Check slideback/video stretch amplifier A210.
Peak analysis mode inoperative; rms and slideback modes operate properly.	Check Schmitt trigger A205, multivibrator/integrator A206, check video buffer/peak driver amplifier A223, peak operational amplifier A217 and peak level voltage comparator A208.
All measurement modes inoperative; video, stretched video, audio, 240 MHz and 60 MHz outputs normal.	Check video buffer/peak driver amplifier A223.
All measurement modes inoperative; no video, stretched video or audio outputs available but 240 MHz and 60 MHz outputs are normal.	Check 60-MHz logarithmic i-f amplifier A221.
All measurement modes inoperative; no video, stretched video, audio or 60 MHz outputs available; 240 MHz output may or may not be present.	Check i-f circuitry as directed in table 4-7. Check r-f attenuator AT101 and associated circuitry.
No audio output.	Check audio amplifier A201.
No video output.	Check 60-MHz logarithmic i-f amplifier.
No stretched video output.	Check slideback/video stretch amplifier A210.
No analog x output.	Check x analog operational amplifier A219.
Equipment cannot be calibrated; reception of applied signal normal.	Check impulse generator driver A104 and impulse generator Z104 (refer to paragraph 4-22).
Tuner does not scan when SWEEP START pushbutton switch is depressed (single scan sweep mode).	Check servo bipolar chopper/preamplifier A103. Check transistors Q101 and Q102. Check relays K206, K204, K207, K101 and associated circuitry. Check scan direction control flip-flop A212.
Tuner does not scan when SWEEP START pushbutton switch is depressed (sector scan sweep mode) but does scan in single scan sweep mode.	Check relay K205 and associated circuitry.
Equipment does not automatically band switch in either single or sector scan sweep modes.	Check clock oscillator A102. Check tuner limit switches.
Frequency Selection Unit will not switch to tuner selected by setting of BAND SWITCH switch.	Check clock oscillator A102.

TABLE 4-5. SYMPTOMATIC TROUBLESHOOTING GUIDE (Cont'd)

Symptom	Possible Cause
Equipment will not reverse scanning direction upon depression of SWEEP REVERSE pushbutton switch. (Note that, if a tuner is scanning up to the low frequency scan limit or down to the high frequency scan limit, momentary depression of the SWEEP REVERSE pushbutton switch will not effect the direction of scan until the tuner is scanning between the selected high and low limits. This particular condition should not be mistaken for a malfunction of the sweep reversing mechanism.)	Check scan direction control flip-flop A212.
Tuner scans beyond selected high frequency limit but reverses direction at the high end of band 4.	Check high frequency analog voltage comparator A216.
Tuner scans beyond selected low frequency limit but reverses direction at the low end of band 1.	Check low frequency analog voltage comparator A215.
Tuner continues to sweep or oscillates erratically when scan high frequency limit is set below low frequency limit.	Check crossover voltage comparator A214.
Scan will not work on one tuner. All other tuners scan and manual tuning normal.	Replace clutch (refer to paragraph 4-30).
Indication of high level signal (SIGNAL PRESENT indicator inoperative) cannot be obtained.	Check signal present voltage comparator A213. Check relays K208, K209 and associated circuitry.
No fm output.	Check 60-MHz i-f amplifier/afc discriminator A222.
Afc inoperative but SIGNAL PRESENT indicator lamp illuminates when attempting to employ afc capability. Single and sector scan sweep modes operate properly.	Check 60-MHz i-f amplifier/afc discriminator A222. Check afc bipolar pulse stretcher A211. Check afc bipolar chopper A106. Check afc pulse amplifier A101. Check afc operational amplifier A115.

TABLE 4-6. R-F CIRCUITRY TROUBLESHOOTING PROCEDURE

Step	Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
1	With the EMA-910 unenergized, disconnect the output cable of the applicable tuner local oscillator from its mating connector on its corresponding balanced mixer. Using an ohmmeter, measure the resistance between the inner and outer conductor of the cable connector.	Ohmmeter indicator infinite resistance (band 1) or 0 ohms (bands 2, 3 and 4).	Proceed to step 2.	Replace defective cable and probe assembly (refer to paragraph 4-29).
2	With the Data Evaluation Unit connected to the Frequency Selection Unit via the supplied power patch cable, set the BAND SWITCH to that position corresponding to the applicable tuner, set the SWEEP MODE switch to MANUAL and set the AFC switch to OFF. Rotate the applicable tuning control fully counterclockwise and couple the local oscillator output cable to a power meter through a thermistor mount. Energize the EMA-910 and allow at least 15 minutes for warmup. Slowly rotate the tuning control throughout the band and note the power meter indication.	Power meter reading is continuous across the band; local oscillator output level is at least 0 dBm.	Proceed to step 3.	Check reflex klystron local oscillator. Replace (refer to paragraph 4-26) if necessary.
3	Insert a frequency meter between the local oscillator output cable and the thermistor mount. With the tuning control adjusted to the high end of the band, determine the local oscillator output frequency. Determine the local oscillator output frequency at two other points within the band.	Band 1 and 3 local oscillator frequency is within ±0.5% of (tuning indicator reading + 240 MHz); band 2 and 4 local oscillator frequency is within ±0.5% of (tuning indicator reading - 240 MHz).	De-energize the EMA-910, disconnect the thermistor mount and power meter and reconnect the local oscillator output cable to its mating connector on the appropriate balanced mixer. Proceed to step 4.	Align the local oscillator as detailed in paragraph 4-15.
4	With the EMA-910 unenergized, disconnect the input cable of the applicable tuner preselector from its mating connector at the output of tuner selector switch Z102. Couple a signal generator to the input of the preselector. Rotate the applicable tuning control to obtain a tuning indicator reading corresponding to the low end of the band and adjust the signal generator for a cw output of 0 dBm at this frequency. Disconnect the output cable of the preselector from its mating connector on either the balanced mixer or isolator and couple the preselector output to a power meter (through a thermistor mount). Determine the level of the signal coupled through the preselector. Repeat this procedure at two other frequencies within the band.	Power meter indicates approximately -9 dBm (0 dBm less the insertion loss of the preselector).	Connect the input cable of the preselector to the output of Z102. Connect the output cable of the preselector to the balanced mixer or isolator. Trouble lies in balanced mixer/240-MHz preamplifier (refer to paragraph 4-18).	Align the preselector as detailed in paragraph 4-19.

TABLE 4-7. I-F CIRCUITRY TROUBLESHOOTING PROCEDURE

Step	Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
1a	Set the METER RESPONSE switch to FAST, set the ANALYSIS MODE switch to RMS, set the BANDWIDTH switch to 0.5 MHZ and disconnect W208P2 from A221J1. Tune an HP 608C signal generator to 60 MHz and adjust for a cw output level of approximately -60 dBm. Couple the signal generator to A221J1 and carefully adjust the signal level to obtain an output meter indication of 0 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -60 (±3) dBm is required to produce output meter indication of 0 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 1b.	Check 60-MHz logarithmic i-f amplifier A221.
1b	Increase the signal generator output level to obtain an output meter indication of 10 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -50 (±3) dBm is required to produce output meter indication of 10 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 1c.	Same as above.
1c	Increase the signal generator output level to obtain an output meter indication of 20 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -40 (±3) dBm is required to produce output meter indication of 20 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 1d.	Same as above.
1d	Increase the signal generator output level to obtain an output meter indication of 30 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -30 (±3) dBm is required to produce output meter indication of 30 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 1e.	Same as above.
1e	Increase the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -20 (±3) dBm is required to produce output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	60-MHz logarithmic i-f amplifier (metering section) operating properly. Remove signal generator, connect W208P2 to A221J1 and proceed to step 2.	Same as above.
2	Disconnect W209P2 from A224J5. With the signal generator still tuned to 60 MHz, adjust the output level to approximately -30 dBm and couple the generator to A224J5. Increase the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Same as for step 1e.	60-MHz signal sampler operating properly. Remove signal generator, connect W209P2 to A224J5 and proceed to step 3.	Check 60-MHz sampler section of A224.

(Cont'd)

TABLE 4-7. I-F CIRCUITRY TROUBLESHOOTING PROCEDURE (Cont'd)

Step	Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
3a	Disconnect W215P2 from Z203J1. With the signal generator still tuned to 60 MHz, adjust the output level to approximately -30 dBm and couple the generator to Z203J1. Adjust the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -10 (±2) dBm is required to produce output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 3b.	Check S202, Z203, Z204, FL204 and associated circuitry. Replace any defective component.
3b	Set the BANDWIDTH switch to 1 MHZ and adjust the signal generator to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -15 (±2) dBm is required to produce output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 3c.	Check S202, Z203, Z204, FL205 and associated circuitry. Replace any defective component.
3c	Set the BANDWIDTH switch to 5 MHZ and adjust the signal generator to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -15 (±2) dBm is required to produce output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 3d.	Check S202, Z203, Z204, FL202 and associated circuitry. Replace any defective component.
3d	Set the BANDWIDTH switch to FULL and adjust the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Same as for step 1e.	Bandwidth limiting filters are operating properly. Remove signal generator, connect W215P2 to Z203J1 and proceed to step 4a.	Check S202, Z203, Z204 and associated circuitry. Replace any defective component.
4a	Set the BANDWIDTH switch to 0.5 MHZ and disconnect W213P2 from A220J1. Rotate the IF GAIN control fully clockwise and, with the signal generator still tuned to 60 MHz, adjust its output level to approximately -70 dBm and couple the generator to A220J1. Increase the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -60 (±7) dBm is required to produce output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 4b.	Check 60-MHz linear i-f amplifier A220.
4b	Rotate the IF GAIN control fully counterclockwise and increase the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -30 (±7) dBm is required to produce output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 4c.	Check IF GAIN control R260 and associated circuitry.

(Cont'd)

TABLE 4-7. I-F CIRCUITRY TROUBLESHOOTING PROCEDURE (Cont'd)

Step	Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
4c	Set the BANDWIDTH switch to 1 MHZ and adjust the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Same as for step 4b.	Proceed to step 4d.	Check 1 MHz screwdriver control R226 and/or S202.
4d	Set the BANDWIDTH switch to 5 MHZ and adjust the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Same as for step 4b.	Proceed to step 4e.	Check 5 MHz screwdriver control R227 and/or S202.
4e	Set the BANDWIDTH switch to FULL and adjust the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Same as for step 4b.	60-MHz linear i-f amplifier A220 and associated bandwidth gain equalization circuitry operating properly. Remove signal generator, connect W213P2 to A220J1 and proceed to step 5a.	Check Full screwdriver control R228 and/or S202.
5a	Disconnect W218P2 from Z202J1. With the signal generator still tuned to 60 MHz, adjust its output level to -40 dBm and couple the generator to Z202J1. Adjust the IF GAIN control to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Output meter indicates 40 on the DB ABOVE 1 MICROVOLT scale.	4 Proceed to step 5b.	Check S203, Z202 and associated circuitry. Replace any defective component.
5b	Set the MULTIPLIER switch to X10[1] +20 DB and note the output meter indication.	Output meter indicates 20 (±0. 5) on the DB ABOVE 1 MICROVOLT scale.	First 20-dB i-f step attenuator operating properly. Remove signal generator, connect W218P2 to Z202J1 and proceed to step 6a.	Adjust A224R2 (see figure 4-7) to obtain an output meter indication of 20 on the DB ABOVE 1 MICROVOLT scale.
6a	Disconnect W220P2 from A225J1. Tune the signal generator to 240 MHz and adjust for a cw output level of approximately -50 dBm. Couple the generator to A225J1 and increase the signal generator output level to obtain an output meter indication of 20 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -49 (±2) dBm is required to produce output meter indication of 20 on the DB ABOVE 1 MICROVOLT scale.	240/60-MHz mixer A225 and 180-MHz oscillator A226 are operating properly. Remove the signal generator, connect W220P2 to A225J1 and proceed to step 7a.	Proceed to step 6b.
6b	Disconnect W219P1 from A226J1. Connect a power meter (through a thermistor mount) to A226J1 and determine the output level of 180-MHz oscillator A226.	Output level of 180-MHz oscillator is at least +7 dBm.	Check 240/60-MHz mixer A225 (refer to paragraph 4-37).	Check 180-MHz oscillator A226.

(Cont'd)

TABLE 4-7. I-F CIRCUITRY TROUBLESHOOTING PROCEDURE (Cont'd)

Step	Procedure	Normal Indication	If Indication is Normal	If Indication is Abnormal
7a	Disconnect W222P2 from Z201J1. With the signal generator still tuned to 240 MHz, adjust its output level to approximately -30 dBm. Couple the generator to Z201J1 and adjust the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -29 (±2) dBm is required to produce output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Proceed to step 7b.	Check S203, Z201 and associated circuitry. Replace any defective components.
7b	Set the MULTIPLIER switch to $X10^2$ +40 DB and note the output meter indication.	Output meter indicates 20 (±0.5) on the DB ABOVE 1 MICROVOLT scale.	Second 20-dB i-f step attenuator operating properly. Remove signal generator, connect W222P2 to Z201J1 and proceed to step 8.	Adjust A224R6 (see figure 4-7) to obtain an output meter indication of 20 on the DB ABOVE 1 MICROVOLT scale.
8	Disconnect W224P2 from FL201J1. With the signal generator still tuned to 240 MHz, adjust its output level to approximately -50 dBm. Set the MULTIPLIER switch to $X10^0$ +0 DB and couple the generator to FL201J1. Adjust the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Signal generator level of -46 (±2) dBm is required to produce output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	240-MHz bandpass filter FL201 operating properly. Remove the signal generator, connect W222P2 to FL201J1 and proceed to step 9.	Replace FL201.
9	With the signal generator still tuned to 240 MHz, adjust its output level to approximately -50 dBm. Couple the generator to the rear panel 240 MHZ INPUT connector and adjust the signal generator output level to obtain an output meter indication of 40 on the DB ABOVE 1 MICROVOLT scale.	Same as for step 8.	Data Evaluation Unit i-f circuitry is operating properly. Remove the signal generator.	Check 240-MHz sampler section of A224.

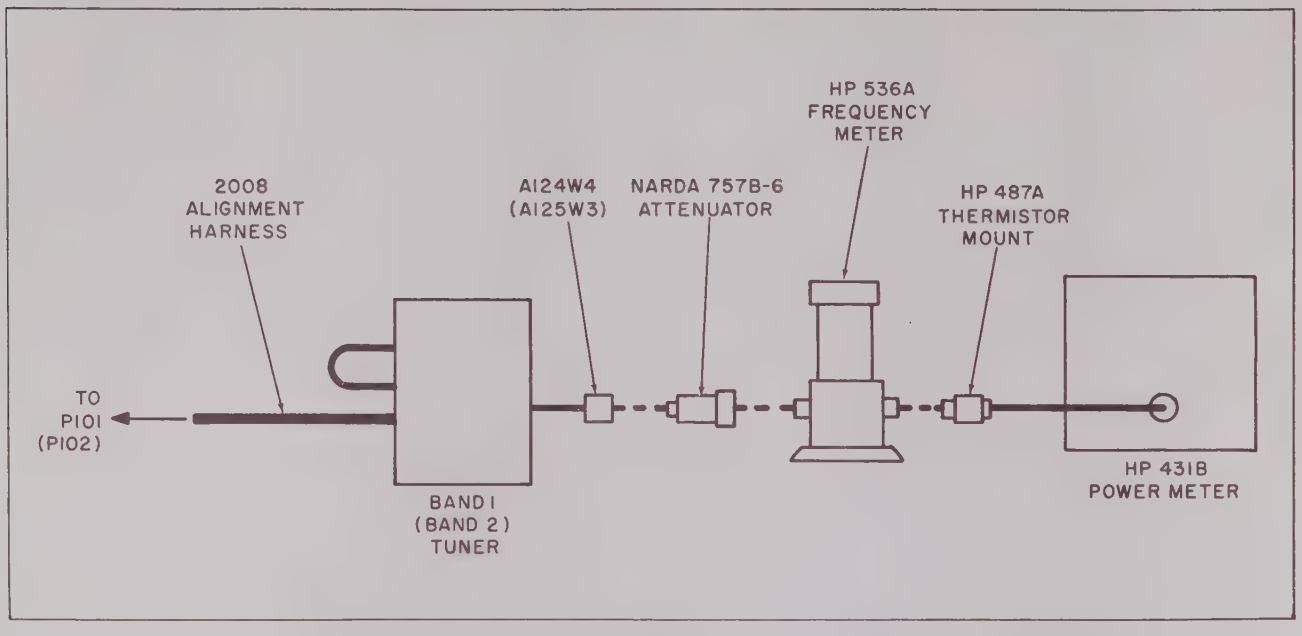


Figure 4-18. Band 1 and Band 2 Local Oscillator Alignment, Equipment Setup

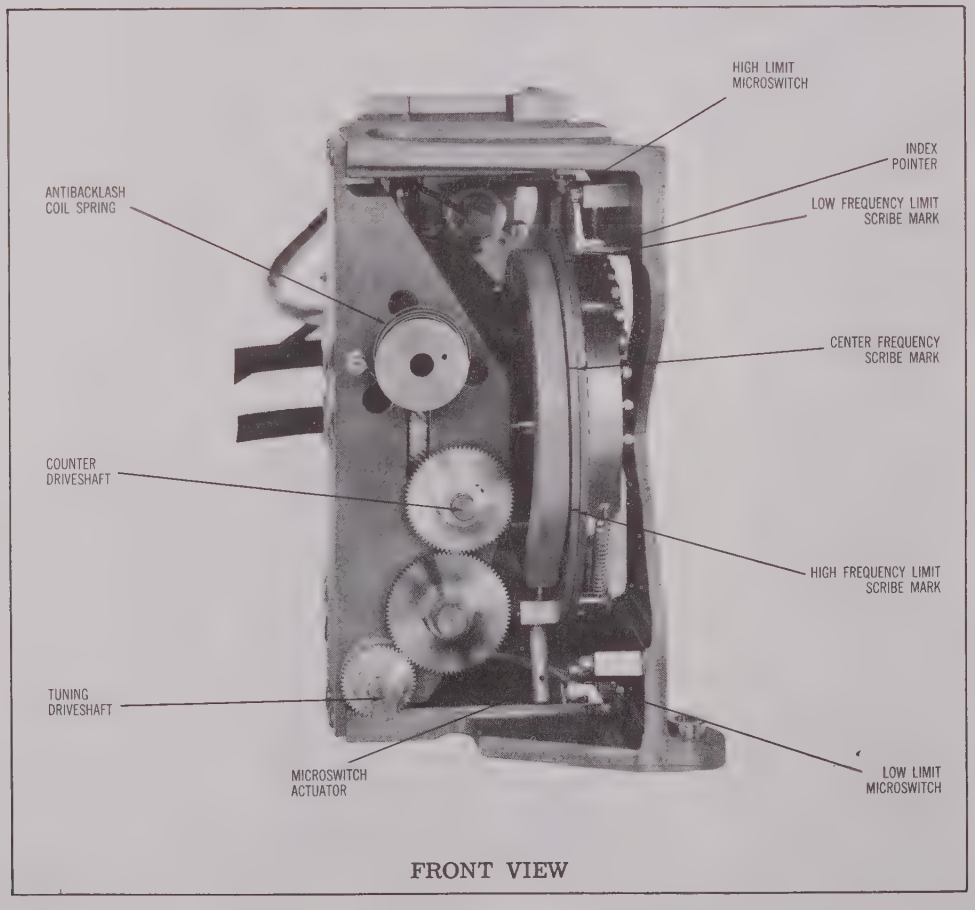
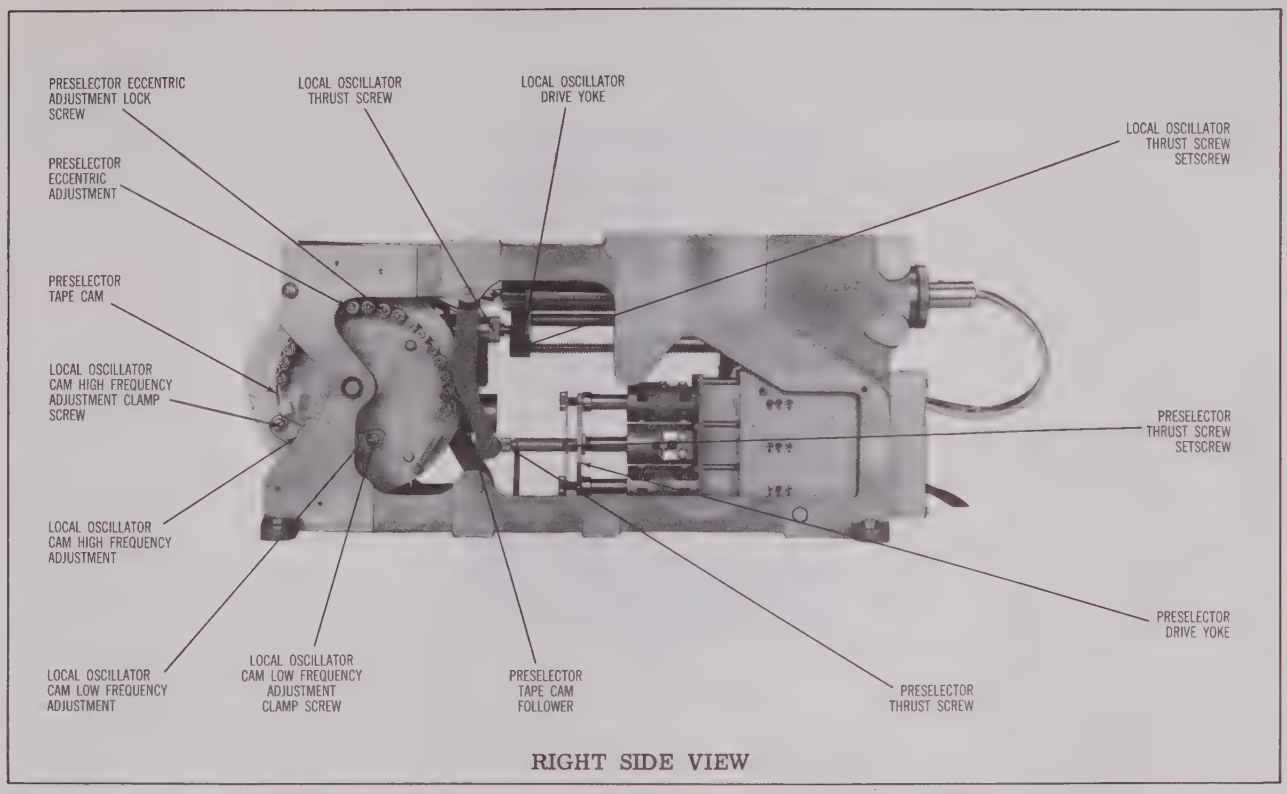
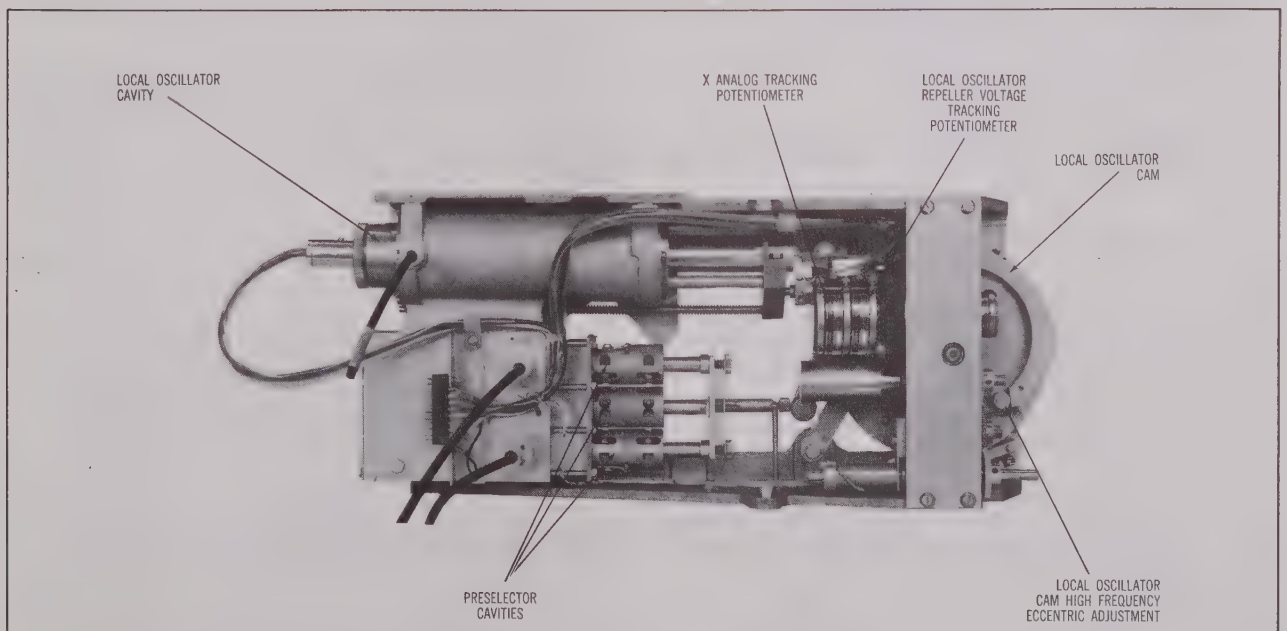


Figure 4-19. Typical Low Band Tuner (Sheet 1 of 3)


PRESELECTOR ECCENTRIC ADJUSTMENT LOCK SCREW
LOCAL OSCILLATOR THRUST SCREW
LOCAL OSCILLATOR DRIVE YOKE
LOCAL OSCILLATOR THRUST SCREW SETSCREW
PRESELECTOR ECCENTRIC ADJUSTMENT
PRESELECTOR TAPE CAM
LOCAL OSCILLATOR CAM HIGH FREQUENCY ADJUSTMENT CLAMP SCREW
PRESELECTOR THRUST SCREW SETSCREW
LOCAL OSCILLATOR CAM HIGH FREQUENCY ADJUSTMENT
PRESELECTOR DRIVE YOKE
LOCAL OSCILLATOR CAM LOW FREQUENCY ADJUSTMENT
LOCAL OSCILLATOR CAM LOW FREQUENCY ADJUSTMENT CLAMP SCREW
PRESELECTOR TAPE CAM FOLLOWER
PRESELECTOR THRUST SCREW

RIGHT SIDE VIEW

Figure 4-19. Typical Low Band Tuner (Sheet 2 of 3)


LOCAL OSCILLATOR CAVITY
X ANALOG TRACKING POTENTIOMETER
LOCAL OSCILLATOR REPELLER VOLTAGE TRACKING POTENTIOMETER
LOCAL OSCILLATOR CAM
PRESELECTOR CAVITIES
LOCAL OSCILLATOR CAM HIGH FREQUENCY ECCENTRIC ADJUSTMENT

LEFT SIDE VIEW

Figure 4-19. Typical Low Band Tuner (Sheet 3 of 3)

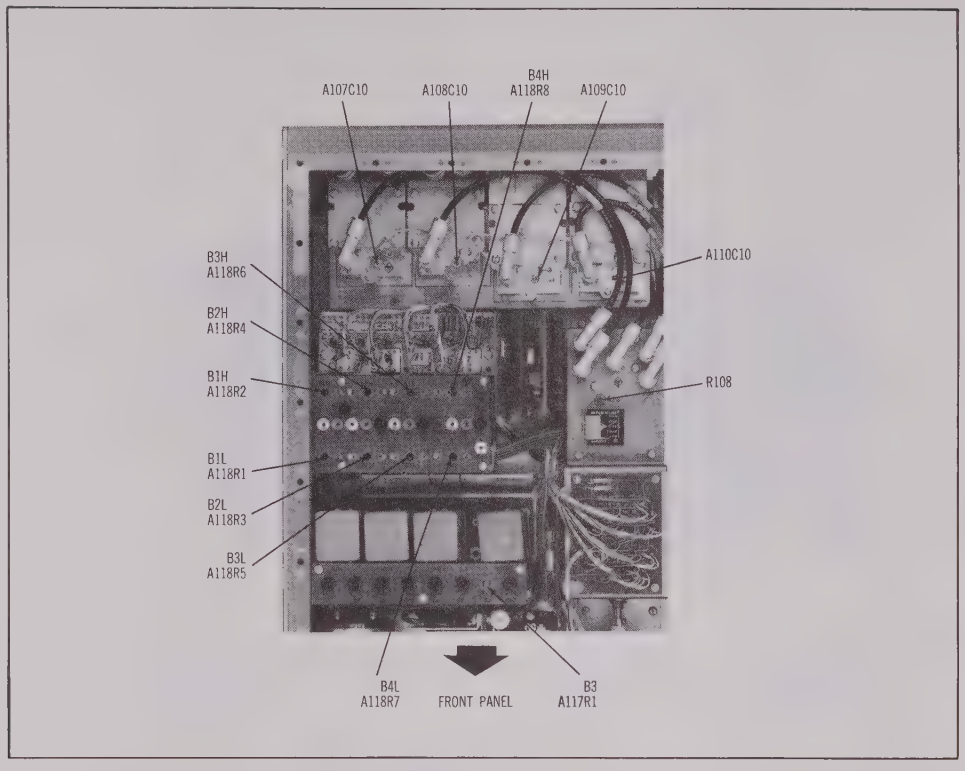


Figure 4-20. Local Oscillator Tracking and Preamplifier Tuning Controls

j. Adjust the B1H screwdriver control A118R2 (B2H screwdriver control A118R4) to obtain a maximum power meter indication.

k. Due to interaction between the high and low limit adjustments, it may be necessary to repeat steps g through j several times until no further adjustment of either control is required to obtain the specified power meter indications.

l. Slowly scan through the band and note the variation in power meter indication; the power meter should read at least 0 dBm across the band.

m. Adjust the knob to position the center frequency scribe mark under the index pointer.

n. Tune the frequency meter to obtain a dip in the power meter reading. Note the frequency meter reading; it should be 1.940 GHz (3.060 GHz). If the frequency meter indicates a frequency other than that specified above, continue as directed in the following additional steps.

1. See figure 4-19. Loosen the local oscillator thrust screw setscrew that secures the position of the local oscillator drive yoke with respect to the local oscillator thrust screw.

2. Carefully adjust the setting of the local oscillator thrust screw, while constantly checking the local oscillator frequency by means of the frequency meter, until an output frequency of 1.940 GHz (3.060 GHz) is obtained.

3. Without further adjustment of the local oscillator thrust screw, carefully tighten the local oscillator thrust screw setscrew to retain this setting.

o. Adjust the knob to position the low frequency limit scribe mark under the index pointer.

p. Tune the frequency meter to obtain a dip in the power meter reading. Note the frequency meter reading; it should be 1.240 GHz (2.160 GHz). If the frequency meter indicates a frequency other than that specified above, continue as directed in the following additional steps.

1. See figure 4-19. Loosen the local oscillator cam low frequency adjustment clamp screw.

2. Carefully adjust the setting of the local oscillator cam low frequency adjustment screw, while simultaneously checking the local oscillator frequency by means of the frequency meter, until an output frequency of 1.240 GHz (2.160 GHz) is obtained.

3. Without further adjustment of the local oscillator cam low frequency adjustment screw, tighten the local oscillator cam low frequency adjustment clamp screw.

q. Adjust the knob to position the high frequency limit scribe mark under the index pointer.

r. Tune the frequency meter to obtain a dip in

the power meter reading. Note the frequency meter reading; it should be within ±0.5% of 2.740 GHz (4.160 GHz). If the frequency meter indicates other than that specified above, continue as directed in the following additional steps.

1. See figure 4-19. Loosen the local os- oscillator cam high frequency adjustment clamp screw.

2. Carefully adjust the setting of the local oscillator cam high frequency adjustment screw, while simultaneously checking the local oscillator frequency by means of the frequency meter, until an output frequency of 2.740 GHz (4.160 GHz) is obtained.

3. Without further adjustment of the local oscillator cam high frequency adjustment screw, tighten the local oscillator cam high frequency adjustment clamp screw.

s. Alignment of the local oscillator will necessitate alignment of the preselector. Refer to paragraph 4-19.

4-17. Bands 3 and 4. To align the band 3 and/or band 4 local oscillator, proceed as directed in the following steps.

Note

The data contained within parenthesis applies to the band 4 local oscillator and immediately follows the equivalent information pertaining to the band 3 local oscillator.

a. With the EMA-910 unenergized and the Data Evaluation Unit coupled to the Frequency Selection Unit, remove the band 3 (band 4) tuner as detailed in paragraph 4-25.

b. Place the tuner beside the Frequency Selection Unit and connect the supplied alignment harness -- EMC Model 2008 -- between P103 (P104) and A126J1 (A127J1).

c. Connect the equipment as illustrated in figure 4-21.

d. Mount a knob on the tuning drive shaft.

e. Set the BAND SWITCH switch to BAND 3 (BAND 4) and set the SWEEP MODE switch to MANUAL.

f. When aligning the band 3 local oscillator only, orient the arrows of the probe so that they point away from the tuner and place the probe around the yellow wire of the alignment harness.

g. Energize the equipment and allow at least 30 minutes for warmup.

CAUTION

DO NOT ALLOW THE CURRENT FLOWING IN THE YELLOW WIRE OF THE ALIGNMENT HARNESS TO EXCEED 23 MILLIAMPERES. BE PREPARED TO ADJUST BS SCREWDRIVER CONTROL A117R1 -- SEE FIGURE 4-20 -- TO LIMIT THIS CURRENT AT 23 MA.

h. When aligning the band 3 local oscillator only, adjust B3 screwdriver control A117R1 to obtain a milliammeter reading of 23 ma. Slowly scan through the band and, if necessary, re-adjust the setting of A117R1 so that the maximum cathode current drawn by the reflex klystron is 23 ma. At the point of maximum cathode current, carefully remove the probe from the yellow wire of the alignment

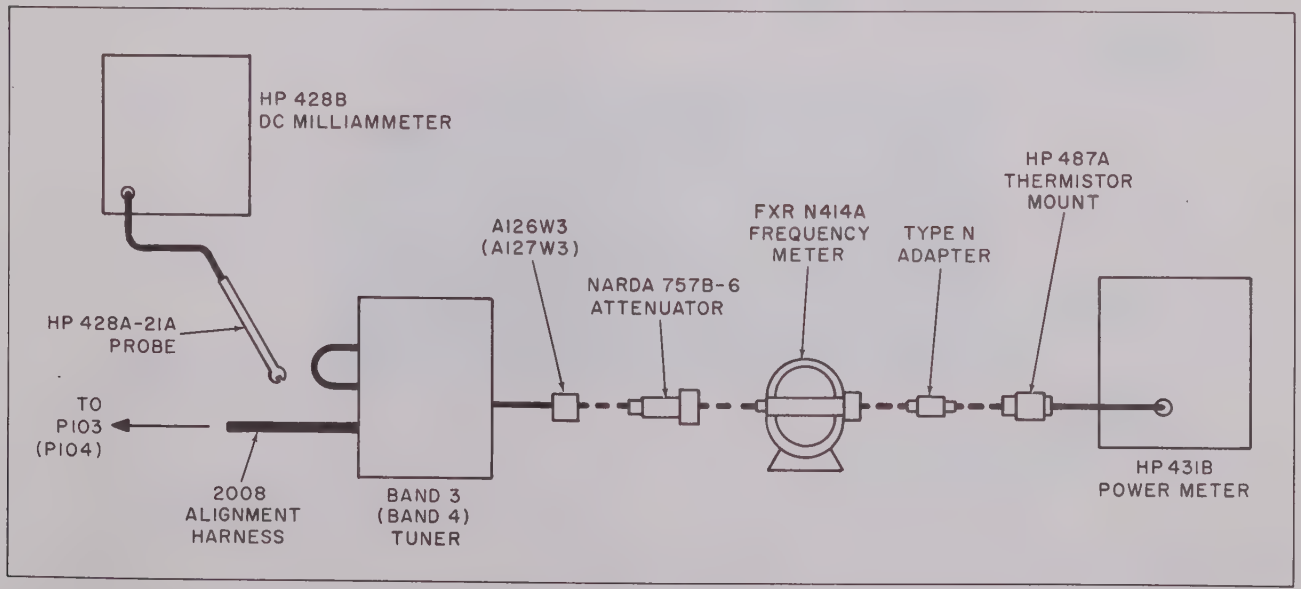


Figure 4-21. Band 3 and Band 4 Local Oscillator Alignment, Equipment Setup

harness and, with the probe arrows pointing toward the tuner, place the probe around the green wire of the alignment harness. Note the grid current drawn by the reflex klystron. Carefully remove the probe from the green wire and again place it, with the arrows pointing away from the tuner, around the yellow wire. Adjust B3 screwdriver control A117R1 so that the milliammeter reading less the noted grid current is equal to 19.5 ma. Carefully remove the probe.

i. Tune the frequency meter to a frequency below the tuner local oscillator low frequency limit of 4.54 GHz (6.96 GHz).

j. Rotate the knob to position the low frequency limit scribe mark under the index pointer.

k. See figure 4-20. Adjust B3L screwdriver control A118R5 (B4L screwdriver control A118R7) to obtain a maximum power meter indication.

l. Adjust the knob to position the high frequency limit scribe mark under the index pointer.

m. Adjust B3H screwdriver control A118R6 (B4H screwdriver control A118R8) to obtain a maximum power meter indication.

n. Due to interaction between the high and low limit adjustments, it may be necessary to repeat steps k through m several times until no further adjustment of either control is required to obtain the specified power meter indications.

o. Slowly scan through the band and note the variation in power meter indication; the power meter should read at least 0 dBm across the band.

p. Adjust the knob to position the center frequency scribe mark under the index pointer.

q. Tune the frequency meter to obtain a dip in the power meter reading. Note the frequency meter reading; it should be within ±0.5% of 5.840 GHz (8.520 GHz). If the frequency meter indicates a frequency other than that specified above, continue as directed in the following additional steps.

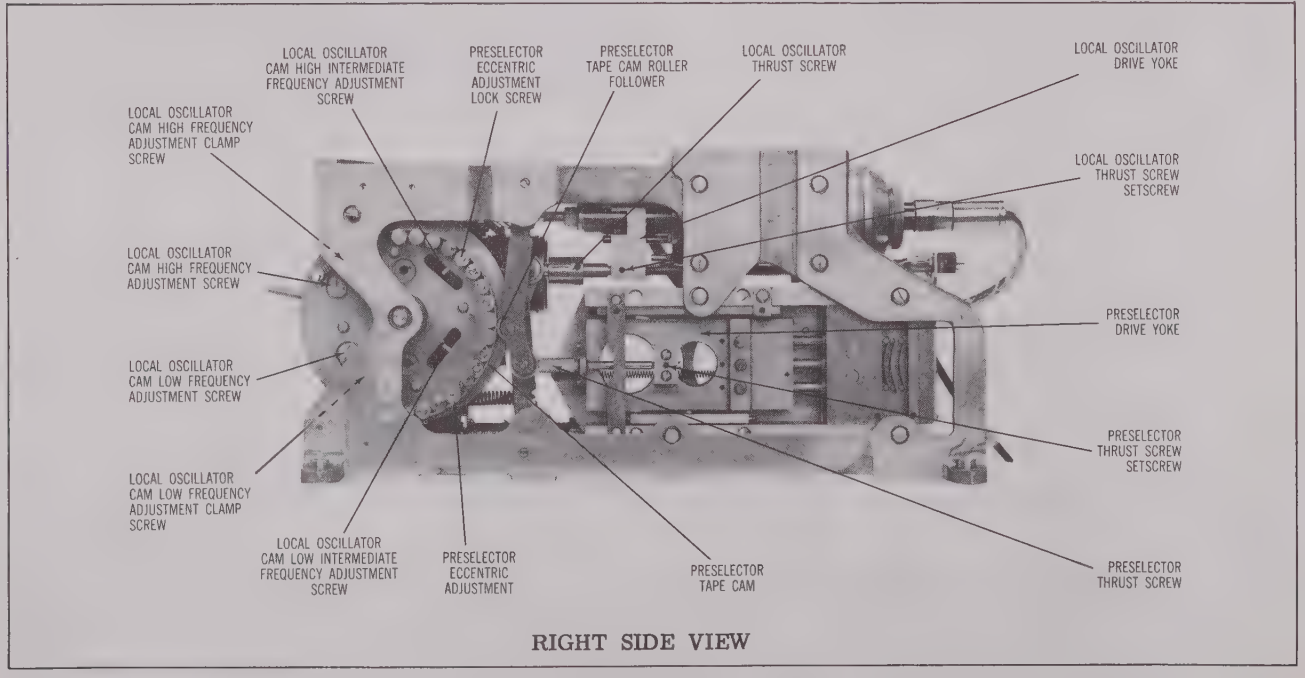
1. See figure 4-22. Loosen the local oscillator thrust screw setscrew that secures the position of the local oscillator drive yoke with respect to the local oscillator thrust screw.

2. Carefully adjust the setting of the local oscillator thrust screw, while constantly checking the local oscillator frequency by means of the frequency meter, until an output frequency of 5.840 GHz (8.520 GHz) is obtained.

3. Without further adjustment of the local oscillator thrust screw, carefully tighten the local oscillator thrust screw setscrew to retain this setting.

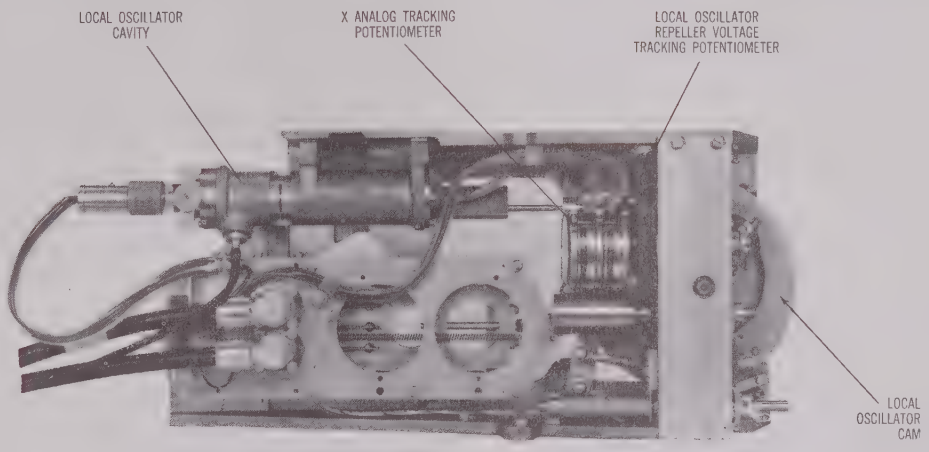
r. Adjust the knob to position the low intermediate frequency scribe mark between the low and center frequency scribe mark under the index pointer.

s. Tune the frequency meter to obtain a dip in the power meter reading. Note the frequency meter reading; it should be 5.140 GHz (7.720 GHz). If the frequency meter indication is other than that specified above, carefully adjust the local oscillator cam low intermediate frequency adjustment screw, while simultaneously checking the local oscillator


LOCAL OSCILLATOR CAM HIGH INTERMEDIATE FREQUENCY ADJUSTMENT SCREW
PRESELECTOR ECCENTRIC ADJUSTMENT LOCK SCREW
PRESELECTOR TAPE CAM ROLLER FOLLOWER
LOCAL OSCILLATOR THRUST SCREW
LOCAL OSCILLATOR DRIVE YOKE
LOCAL OSCILLATOR CAM HIGH FREQUENCY ADJUSTMENT CLAMP SCREW
LOCAL OSCILLATOR THRUST SCREW SETSCREW
LOCAL OSCILLATOR CAM HIGH FREQUENCY ADJUSTMENT SCREW
PRESELECTOR DRIVE YOKE
LOCAL OSCILLATOR CAM LOW FREQUENCY ADJUSTMENT SCREW
PRESELECTOR THRUST SCREW SETSCREW
LOCAL OSCILLATOR CAM LOW FREQUENCY ADJUSTMENT CLAMP SCREW
LOCAL OSCILLATOR CAM LOW INTERMEDIATE FREQUENCY ADJUSTMENT SCREW
PRESELECTOR ECCENTRIC ADJUSTMENT
PRESELECTOR TAPE CAM
PRESELECTOR THRUST SCREW

RIGHT SIDE VIEW

Figure 4-22. Typical High Band Tuner (Sheet 1 of 2)


LOCAL OSCILLATOR CAVITY
X ANALOG TRACKING POTENTIOMETER
LOCAL OSCILLATOR REPELLER VOLTAGE TRACKING POTENTIOMETER
LOCAL OSCILLATOR CAM

LEFT SIDE VIEW

Figure 4-22. Typical High Band Tuner (Sheet 2 of 2)

frequency by means of the frequency meter, until an output frequency of 5.140 GHz (7.720 GHz) is obtained.

t. Adjust the knob to position the low frequency limit scribe mark under the index pointer.

u. Tune the frequency meter to obtain a dip in the power meter reading. Note the frequency meter reading; it should be 4.540 GHz (6.960 GHz). If the frequency meter indicates a frequency other than that specified above, continue as directed in the following additional steps.

1. See figure 4-22. Loosen the local oscillator cam low frequency adjustment clamp screw.

2. Carefully adjust the setting of the local oscillator cam low frequency adjustment screw, while simultaneously checking the local oscillator frequency by means of the frequency meter, until an output frequency of 4.540 GHz (6.960 GHz) is obtained.

3. Without further adjustment of the local oscillator cam low frequency adjustment screw, tighten the local oscillator cam low frequency adjustment clamp screw.

v. Adjust the knob to position the high intermediate frequency scribe mark between the high and center frequency scribe mark under the index pointer.

w. Tune the frequency meter to obtain a dip in the power meter reading. Note the frequency meter reading; it should be 6.740 GHz (9.510 GHz). If the frequency meter indication is other than that specified above, carefully adjust the local oscillator cam high intermediate frequency adjustment screw, while simultaneously checking the local oscillator frequency by means of the frequency meter, until an output frequency of 6.740 GHz (9.510 GHz) is obtained.

x. Adjust the knob to position the high frequency limit scribe mark under the index pointer.

y. Tune the frequency meter to obtain a dip in the power meter reading. Note the frequency meter reading; it should be 7.540 GHz (10.260 GHz). If the frequency meter indicates a frequency other than that specified above, continue as directed in the following additional steps.

1. See figure 4-22. Loosen the local oscillator cam high frequency adjustment clamp screw.

2. Carefully adjust the setting of the local oscillator cam high frequency adjustment screw, while simultaneously checking the local oscillator frequency by means of the frequency meter, until an output frequency of 7.540 GHz (10.260 GHz) is obtained.

3. Without further adjustment of the local oscillator cam high frequency adjustment screw, tighten the local oscillator cam high frequency adjustment clamp screw.

z. Alignment of the local oscillator will necessitate alignment of the preselector. Refer to paragraph 4-19.

4-18. 240-MHZ PREAMPLIFIERS, ALIGNMENT PROCEDURE. The alignment procedure for the preamplifiers are contained in the following steps.

a. With the EMA-910 unenergized and the Frequency Selection Unit placed upside-down, disconnect (at the preamplifier output) the cable to Z103.

b. Disconnect the local oscillator output cable and/or lowpass filter from the mixer input connector.

c. Disconnect the preselector output cable and/or isolator from the other mixer input connector.

d. Unsolder the -24 volt power lead from the preamplifier feedthrough.

e. Remove the three screws (one on each side of the preamplifier and the third near the output connector) which secures the mixer/preamplifier to the Frequency Selection Unit shelf. Carefully withdraw the mixer/preamplifier from the Frequency Selection Unit.

f. Remove the screws that secure the top and bottom cover plates to the preamplifier casting. Remove the plates; the components within the preamplifier will now be visible and accessible (see figure 4-23).

g. Place a sheet of cardboard over the Frequency Selection Unit and place the mixer/preamplifier on the cardboard.

h. Solder the -24 volt power lead to the preamplifier feedthrough and ground the preamplifier casting to Frequency Selection Unit ground.

i. Couple the Frequency Selection Unit to the Data Evaluation Unit using the supplied power patch cable. Set the BAND SWITCH switch to the position corresponding to the preamplifier under test and energize the EMA-910. Allow a few minutes for warmup.

j. Measure the voltages at Q1 and Q2 (see figure 4-23 and table 4-10). Replace any defective component.

k. Tune an HP 608C signal generator to 240 MHz and adjust for a cw output level of -30 dBm. Set the signal generator for 30% amplitude modulation @ 1 kHz and couple the generator to the junction of L1 and C2. Trace the signal, using a high-impedance probe (see figure 4-24) in conjunction with an oscilloscope, to locate any discontinuity. Effect the necessary repairs and/or replacements.

l. De-energize the EMA-910 and disconnect the test equipment.

m. Unsolder the -24 volt power lead from the preamplifier feedthrough.

n. Replace the bottom cover plate and mount the mixer/preamplifier in place on the Frequency Selection Unit shelf using the three screws removed in step e.

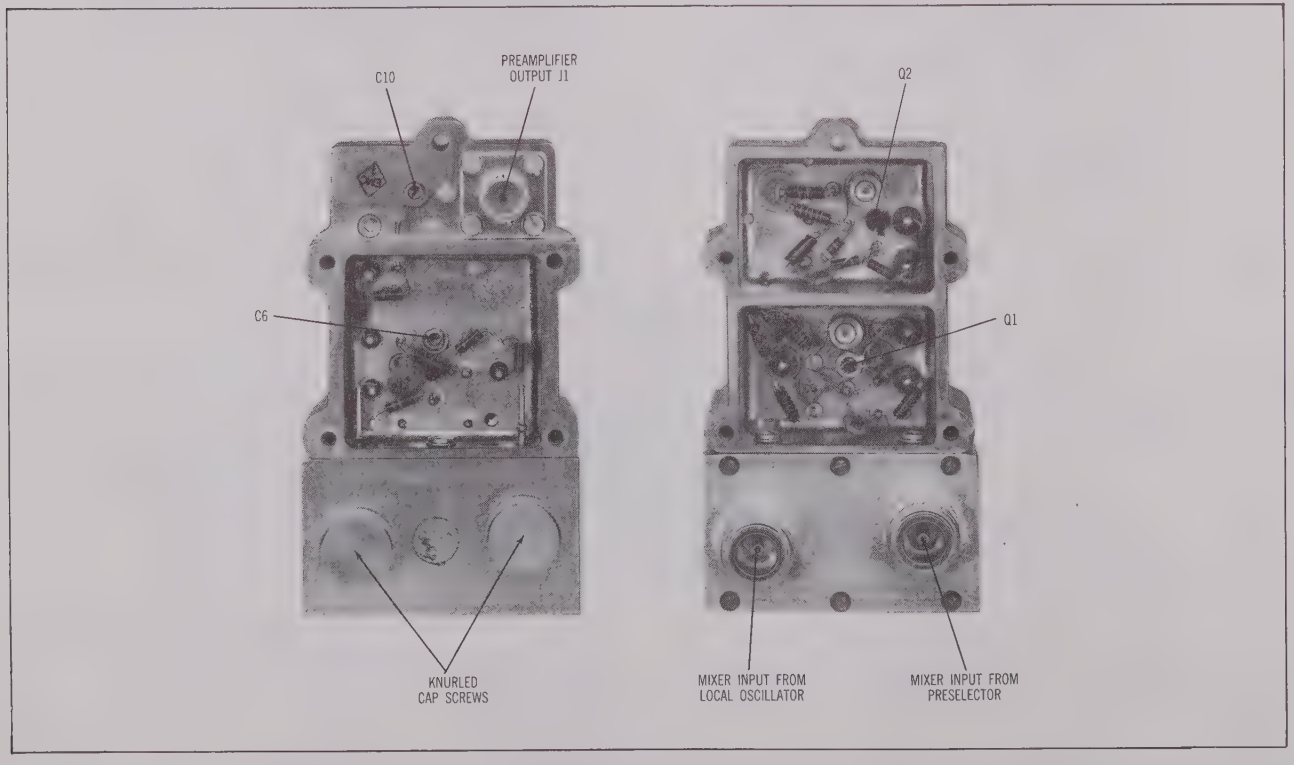


Figure 4-23. Balanced Mixer/240-MHz Preamplifiers (Bands 1 and 2)

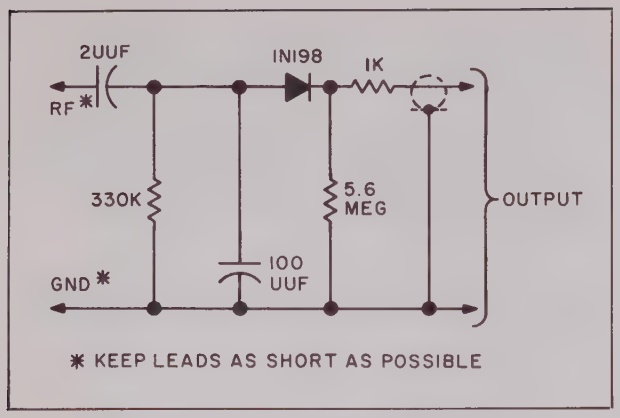


Figure 4-24. High-impedance Probe, Schematic Diagram

o. Resolder the -24 volt power lead to the preamplifier feedthrough.

p. Connect the local oscillator output cable and/or lowpass filter to the appropriate mixer input connector. Connect the cable from Z103 to the preamplifier output connector.

q. Couple the Frequency Selection Unit 240 MHZ OUTPUT connector to the Data Evaluation Unit 240 MHZ INPUT connector using the supplied i-f patch cable.

r. Couple a microwave signal generator (see table 4-8) to the other mixer input connector.

s. Set the BANDWIDTH switch to 1 MHZ, set the MULTIPLIER switch to $X10^0$ +0 DB, set the ANALYSIS MODE switch to RMS and energize the equipment. Allow at least 30 minutes for warmup.

TABLE 4-8. PREAMPLIFIER ALIGNMENT DATA

Band	Signal Generator	Set Tuner and Signal Generator to
1	HP 614A	1.70 GHz
2	HP 618B	4.30 GHz
3	HP 618B	4.30 GHz
4	HP 620A	8.20 GHz

t. Adjust both the appropriate tuning control and the signal generator to the frequency listed in table 4-8.

u. With the signal generator adjusted for minimum output level, adjust the IF GAIN control to obtain an output meter indication of 95 on the -DBM scale.

v. Increase the signal generator output level, while simultaneously rocking the generator tuning control about the frequency to which the EMA-910 is tuned, until the output meter pointer deflects to a maximum (for a given generator output level), indicating that the EMA-910 is tuned to the applied signal.

w. Decrease the signal generator output level to -85 dBm.

x. Alternately adjust C6 and C10 (see figure 4-23) until a maximum output meter indication is obtained.

y. Check for preamplifier oscillation by de-energizing the EMA-910 and disconnecting the local oscillator output cable from the mixer input. Re-energize the EMA-910 and note the output meter indication; if the pointer deflects to an off-scale indication, C6 has been set too far clockwise. Detune C6 slightly to eliminate the oscillation. De-energize the EMA-910, replace the local oscillator output cable and remove the signal generator.

z. Connect the preselector output cable and/or isolator to the other mixer input connector. Replace the top cover plate to the preamplifier casting.

4-19. PRESELECTOR ALIGNMENT. The procedure for aligning the band 1 and band 4 preselector is detailed in paragraph 4-20; that for the band 2 and band 3 preselector is described in paragraph 4-21.

WARNING

VOLTAGES DANGEROUS TO HUMAN LIFE EXIST WITHIN THE TUNERS. OBSERVE EXTREME CAUTION WHEN ADJUSTING ANY ENERGIZED TUNER.

4-20. Bands 1 and 4. To align the band 1 and/or band 4 preselector, proceed as directed in the following steps.

Note

The data contained within parenthesis applies to the band 4 tuner and immediately follows the equivalent information pertaining to the band 1 tuner.

a. With the EMA-910 unenergized and the tuner withdrawn from the Frequency Selection Unit, interconnect the Data Evaluation Unit to the Frequency Selection Unit by means of the supplied power patch cable.

b. Place the tuner beside the Frequency Selection Unit and mount a knob on the tuner drive shaft.

c. Set the BAND SWITCH to BAND 1 (BAND 4), set the MULTIPLIER switch to $X10^2$ +40 DB, set the SWEEP MODE switch to MANUAL, set the IF GAIN control to mid-range and set the BANDWIDTH switch to FULL.

d. Adjust the tuner knob to position the low frequency limit scribe mark under the index pointer.

e. Interconnect the equipment as illustrated in figure 4-25, coupling the output of the step attenuator to the thermistor mount.

f. Energize the equipment and allow at least 30 minutes for warmup.

g. Tune the sweep oscillator for a cw output at 1.0 (7.2) GHz. Adjust the step attenuator and/or sweep oscillator vernier attenuator to obtain a power meter indication of -7 dBm. Once this level is obtained, insert 40 dB more of step attenuation. The output level of the sweep oscillator is now set at -47 dBm.

h. Adjust the sweep oscillator for a sweep width of 50 MHz and set for a Δf output. Couple the sweep oscillator output to the preselector input as illustrated in figure 4-25.

i. Note the position of the preselector tape cam roller follower with respect to the series of preselector eccentric adjustments. If the roller follower lies directly over an eccentric adjustment -- as shown in figure 4-26a -- and, using the alignment tool supplied, carefully loosen the eccentric adjustment lock screw, set the eccentric adjustment to mid-range and then tighten the lock screw. If the roller follower lies between eccentric adjustments -- as shown in figure 4-26b -- carefully loosen the upper eccentric adjustment lock screw, set the eccentric adjustment to mid-range and then tighten the lock screw.

j. Carefully loosen the preselector thrust screw setscrew and adjust the setting of the thrust screw. Note that three maximum deflection points appear on the oscilloscope as the thrust screw is adjusted, as illustrated in figure 4-27. Set the thrust screw so that the middle maximum appears at the center of the display. Tighten the thrust screw setscrew.

k. Rotate the tuner knob clockwise so that the roller follower lies directly over the next eccentric adjustment. Increase the sweep oscillator center frequency, resetting its output level to -47 dBm as detailed in step g, to obtain an on-screen oscilloscope display.

l. Using the supplied alignment tool, carefully loosen the lock screw of the eccentric adjustment under the roller follower. Adjust the setting of the eccentric adjustment to once again center the middle maximum on the oscilloscope display. Tighten the eccentric adjustment lock screw.

m. Repeat steps k and l for each of the remaining eccentric adjustments.

n. Due to interaction between eccentric adjustment settings, it may be necessary to perform steps e and g through m a second time.

o. After the preselector has been aligned, deenergize and disconnect the equipment, remove the knob from the tuner drive shaft and replace the tuner into the Frequency Selection Unit as detailed in paragraph 4-25.

4-21. Bands 2 and 3. To align the band 2 and/or band 3 preselector, proceed as directed in the following steps.

Note

The data contained within parenthesis applies to the band 3 tuner and immediately follows the equivalent information pertaining to the band 2 tuner.

a. With the EMA-910 unenergized and the tuner withdrawn from the Frequency Selection Unit, interconnect the Data Evaluation Unit and the Frequency Selection Unit by means of the supplied power patch cable.

b. Place the tuner beside the Frequency Selection Unit and mount a knob on the tuner drive shaft.

c. Set the BAND SWITCH to BAND 2 (BAND 3), set the MULTIPLIER switch to $X10^2$ +40 DB, set the SWEEP MODE switch to MANUAL, set the IF GAIN control to mid-range and set the BANDWIDTH switch to FULL.

d. Adjust the tuner knob to position the high frequency limit scribe mark under the index pointer.

e. Interconnect the equipment as illustrated in figure 4-25, coupling the output of the step attenuator to the thermistor mount.

f. Energize the equipment and allow at least 30 minutes for warmup.

g. Tune the sweep oscillator for a cw output at 4.4 (7.3) GHz. Adjust the step attenuator and/or sweep oscillator vernier attenuator to obtain a power meter indication of -7 dBm. Once this level is obtained, insert 40 dB more of step attenuation. The output level of the sweep oscillator is now set at -47 dBm.

h. Adjust the sweep oscillator for a sweep width of 50 MHz and set for a Δf output. Couple the step attenuator output to the preselector input as illustrated in figure 4-25.

i. Note the positon of the preselector tape cam roller follower with respect to the series of preselector eccentric adjustments. If the roller follower lies directly over an eccentric adjustment -- as shown in figure 4-26a -- and, using the alignment

NOTES:

1. Couple local oscillator output cable to balanced mixer input connector.
2. Couple preselector output cable to balanced mixer input connector.
3. Couple alignment harness to P101, P102, P103 or P104, as required.

Tuner	Frequency Range	Plug-In R-f Unit
Band 1	1-2 GHz 2-2.5 GHz	8691B 8692B
Band 2	2.4-4 GHz 4-4.4 GHz	8692B 8693B
Band 3	4.3-7.3 GHz	8693B
Band 4	7.2-8 GHz 8-10.5 GHz	8693B 8694B

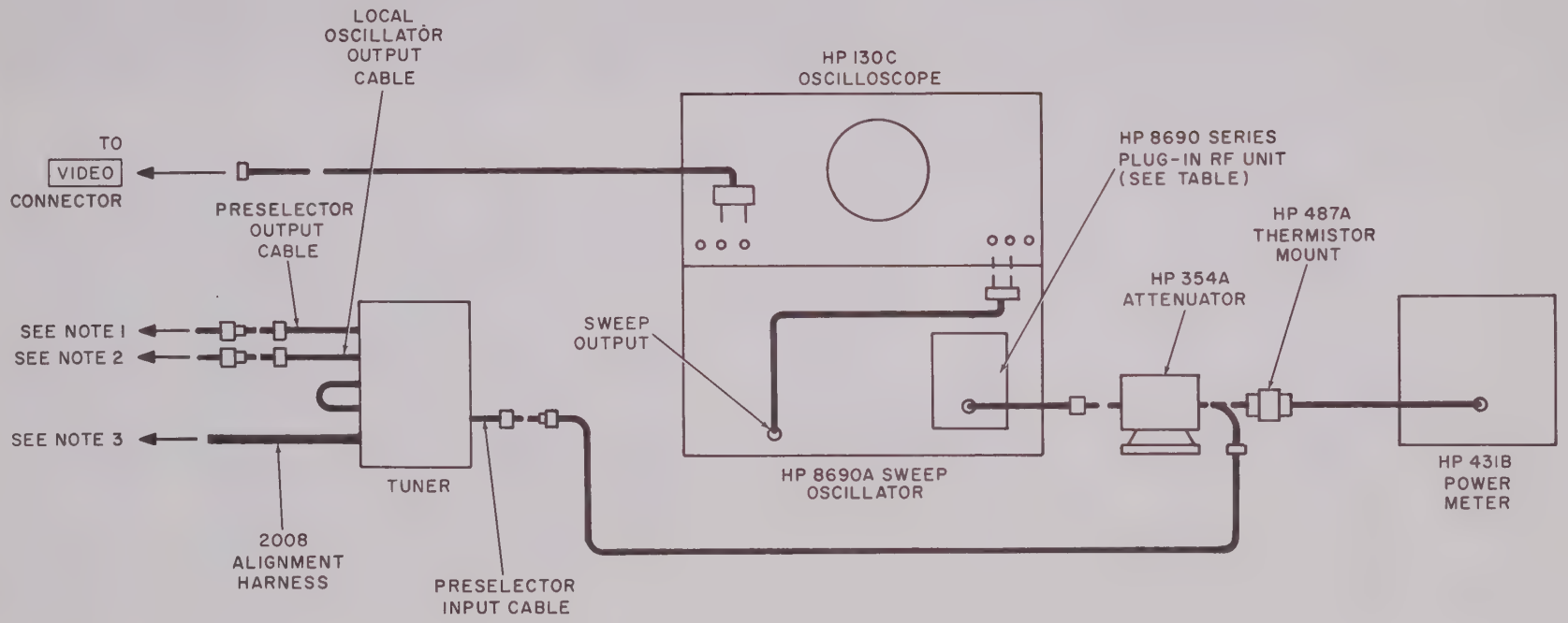


Figure 4-25. Preselector Alignment Setup

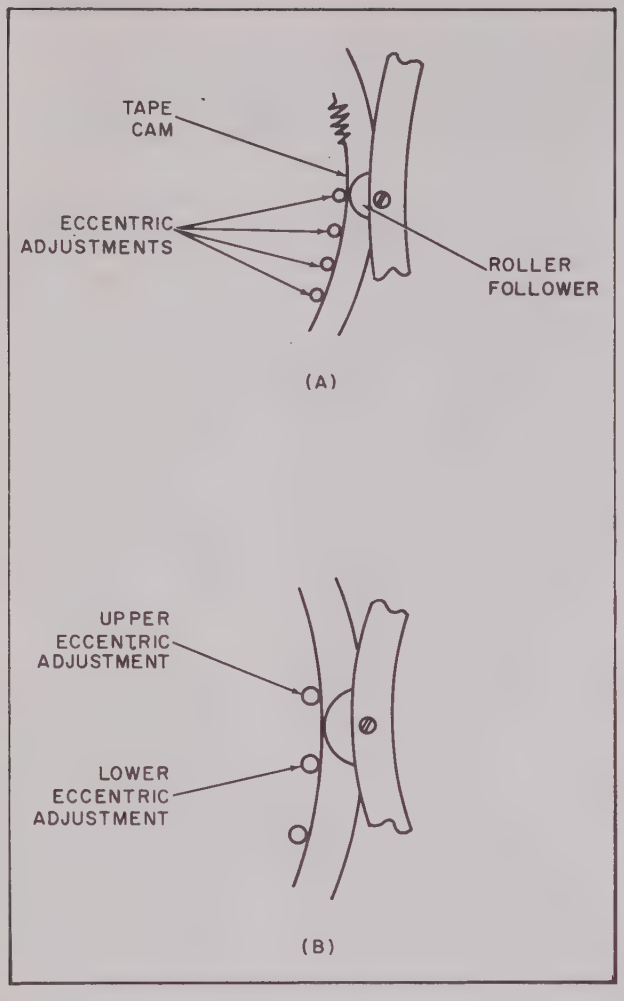


Figure 4-26. Orientation of Preselector Eccentric Adjustments

tool supplied, carefully loosen the eccentric adjustment lock screw, set the eccentric adjustment to mid-range and then tighten the lock screw. If the roller follower lies between eccentric adjustments -- as shown in figure 4-26b -- carefully loosen the lower eccentric adjustment lock screw, set the eccentric adjustment to mid-range and then tighten the lock screw.

j. Carefully loosen the preselector thrust screw setscrew and adjust the setting of the thrust screw. Note that three maximum deflection points appear on the oscilloscope screen as the thrust screw is adjusted, as illustrated in figure 4-27. Set the thrust screw so that the middle maximum appears at the center of the display. Tighten the thrust screw setscrew.

k. Rotate the tuner knob counterclockwise so that the roller follower lies directly over the next eccentric adjustment. Decrease the sweep oscillator center frequency, resetting its output level to -47 dBm as detailed in step g, to obtain an on-screen oscilloscope display.

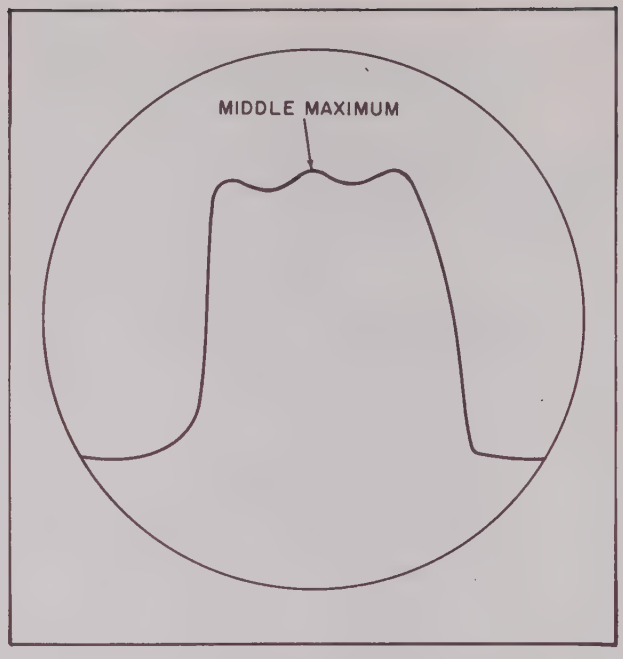


Figure 4-27. Oscilloscope Waveforms During Preselector Alignment

l. Using the supplied alignment tool, carefully loosen the lock screw of the eccentric adjustment under the roller follower. Adjust the setting of the eccentric adjustment to once again center the middle maximum on the oscilloscope display. Tighten the eccentric adjustment lock screw.

m. Repeat steps k and l for each of the remaining eccentric adjustments.

n. Due to interaction between eccentric adjustment settings, it may be necessary to perform steps e and g through m a second time.

o. After the preselector has been aligned, deenergize and disconnect the equipment, remove the knob from the tuner drive shaft and replace the tuner into the Frequency Selection Unit as detailed in paragraph 4-24.

4-22. IMPULSE CALIBRATOR, TROUBLESHOOTING PROCEDURE. To troubleshoot the impulse calibrator circuitry, proceed as directed in the following steps.

a. With the EMA-910 unenergized and the Frequency Selection Unit coupled to the Data Evaluation Unit by means of the supplied power patch cable, withdraw impulse generator driver A104 from J146.

b. Using an ohmmeter, measure the resistance between terminals 2 and 5 of J146; this resistance should be approximately 200 ohms. If this value of resistance is not measured, the trouble has been localized to impulse generator Z104. Remove the impulse generator from the Frequency Selection Unit and return it to EMC Instrumentation, Inc.,

for repair or replacement. If the proper value of resistance is measured, check impulse generator driver A104 (see figure 4-28) in conjunction with extender board 80362-16.

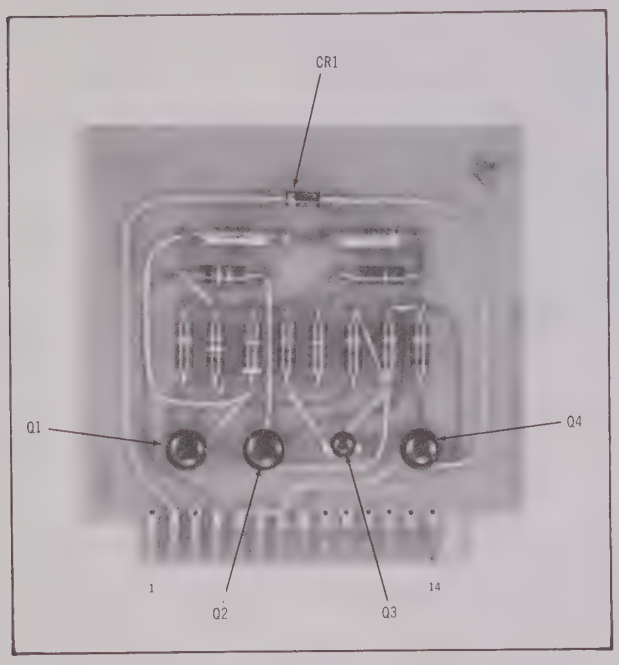


Figure 4-28. Impulse Calibrator Driver A104

4-23. R-F COMPONENT REMOVAL AND REPLACEMENT PROCEDURES.

4-24. The procedures for the removal and replacement of the various r-f components within the Frequency Selection Unit are contained in paragraphs 4-25 through 4-30.

4-25. TUNER REMOVAL. To remove any tuner, proceed as directed in the following steps.

a. With the EMA-910 unenergized, remove the screws that secure the top, bottom and rear dust covers to the Frequency Selection Unit. Remove the dust covers and their associated r-f gaskets.

b. Disconnect all four cables at the output of Z102. (When removing the band 1 tuner, also disconnect the preselector input cable from low-pass filter A124FL1 and remove both the filter and W105.)

c. Turn the Frequency Selection Unit upside-down and carefully remove the socket from the base of the appropriate tuner reflex klystron tube.

d. Disconnect the multipin power connector from from its mating receptacle on the tuner.

e. Disconnect the tuner local oscillator output cable from its mating receptacle on the balanced mixer.

f. Disconnect the preselector output cable from its mating receptacle on the balanced mixer (bands 1 or 2) or isolator (bands 3 or 4). When removing the band 3 or band 4 tuner, also remove the isolator.

g. Rotate the tuning control of the appropriate tuner fully counterclockwise.

h. Loosen the two coupler setscrews (at the tuner main drive shaft) to disengage the linkage between the tuning control and the tuner main drive shaft.

i. Loosen the two coupler setscrews (at the tuner counter drive output shaft) to disengage the linkage between the tuner and the frequency counter.

j. Remove the three screws (and associated hardware) that secures the tuner to the Frequency Selection Unit shelf.

k. Carefully slide the tuner toward the rear of the Frequency Selection Unit until the couplers no longer engage the shafts.

Note

When removing the band 2 tuner, perform steps c through j above on the band 1 tuner. When these steps have been completed, carefully slide the band 1 tuner toward the rear of the Frequency Selection Unit to facilitate removal of the band 2 tuner.

CAUTION

OBSERVE EXTREME CARE WHEN REMOVING ANY TUNER TO ENSURE THAT THE REFLEX KLYSTRON TUBE IS NOT DAMAGED.

l. Carefully grasp the front end of the tuner and lift approximately two inches. Grasp the rear end of the tuner with the free hand and carefully withdraw the tuner from the Frequency Selection Unit.

m. To replace the tuner, follow the above steps in reverse order. Do not tighten the two couple setscrews at the tuner counter drive output shaft. Set up the digital counter as directed in the remaining steps.

n. Adjust the front panel tuning control to position the low frequency limit scribe mark directly under the index pointer.

o. Adjust the digital counter shaft so that the counter indicates the low frequency limit of the tuner (i.e., 1.00, 2.40, 4.30 or 7.20).

p. Carefully tighten the two setscrews to secure the linkage between the tuner and frequency counter.

4-26. REPLACEMENT OF REFLEX KLYSTRON TUBE. To replace the reflex klystron local oscillator tube, proceed as directed in either paragraph 4-27 or 4-28.

4-27. Bands 1, 2 and 4.

a. Remove the tuner from the Frequency Selection Unit as detailed in paragraph 4-25.

b. Viewing the tuner from the tube end, carefully rotate the klystron retaining ring counterclockwise and remove it from the cavity.

c. Grasp the protruding portion of the reflex klystron tube and, while imparting a clockwise twisting motion to the tube, remove it from the cavity.

d. Insert a replacement reflex klystron tube into the open end of the cavity and, while imparting a clockwise twisting motion to the tube, carefully press it into the cavity. Continue pressing the tube further into the cavity, while simultaneously twisting clockwise, until a positive stop is encountered.

e. Carefully replace and tighten the retaining ring to secure the seated klystron tube to the cavity. Use finger pressure only.

g. Align the local oscillator as detailed in paragraph 4-15.

4-28. Band 3.

a. Remove the tuner from the Frequency Selection Unit as described in paragraph 4-25.

b. Loosen the knurled nut to free the tube clamp.

c. Continue as directed in steps c through f of paragraph 4-27.

4-29. LOCAL OSCILLATOR PROBE REPLACEMENT. To replace any local oscillator probe, proceed as directed in the following steps.

a. Remove the tuner as directed in paragraph 4-25.

b. Loosen the single setscrew (using a #6 Allen wrench) that secures the probe to the local oscillator barrel. Carefully withdraw the probe.

Note

Prior to inserting the replacement band 2, band 3 or band 4 probe, make certain that it is oriented so that the flat on the side of the band 2 probe faces the setscrew, the pin on the side of the band 3 probe slides into its corresponding hole and the ball on the band 4 probe slides into its corresponding groove.

c. Insert the probe until it is properly seated.

d. Lock the setscrew to secure the probe to the local oscillator barrel.

4-30. REMOVAL OF SERVO DRIVE A121. To gain access to the components on this assembly, proceed as follows.

a. With the Frequency Selection Unit unenergized, remove all four tuners (refer to paragraph 4-25).

b. Disconnect multipin power connector J149 from A121J1.

c. Remove the tuning control crank knobs from the Frequency Selection Unit front panel.

d. Remove the hex nut from the protruding tuning shafts.

e. Remove the front panel overlay plate.

f. Remove the 12 screws that secure the servo drive assembly to the front panel and carefully remove the assembly. Note that factory replacement is suggested for the servomotor and/or clutches.

4-31. I-F CIRCUITRY TROUBLESHOOTING AND ALIGNMENT PROCEDURES.

4-32. The procedures for troubleshooting and aligning the i-f circuits within the Data Evaluation Unit are contained in paragraphs 4-33 through 4-36.

4-33. 60-MHZ LOGARITHMIC I-F AMPLIFIER A221, ALIGNMENT. To align the 60-MHz logarithmic i-f amplifier, proceed as directed in the following steps.

a. Set a Simpson 260 VOM to the RX100 range (+DC).

b. With the EMA-910 unenergized, connect the + lead of the vom to the junction of R7 and L5 (test point 1A in figure 4-29) and connect the common lead to the junction of R8 and C10 (test point 1B). Adjust R8 to obtain a vom indication of 1000 ohms.

c. Connect the + lead of the vom to the junction of L5 and L8 (test point 2A in figure 4-29) and connect the common lead to the junction of R14 and C13 (test point 2B). Adjust R14 to obtain a vom indication of 1200 ohms.

d. Connect the + lead of the vom to the junction of L8 and L11 (test point 3A in figure 4-29) and connect the common lead to the junction of R20 and C18 (test point 3B). Adjust R20 to obtain a vom indication of 1500 ohms.

e. Connect the + lead of the vom to the junction of L11 and L14 (test point 4A in figure 4-29) and connect the common lead to the junction of R26

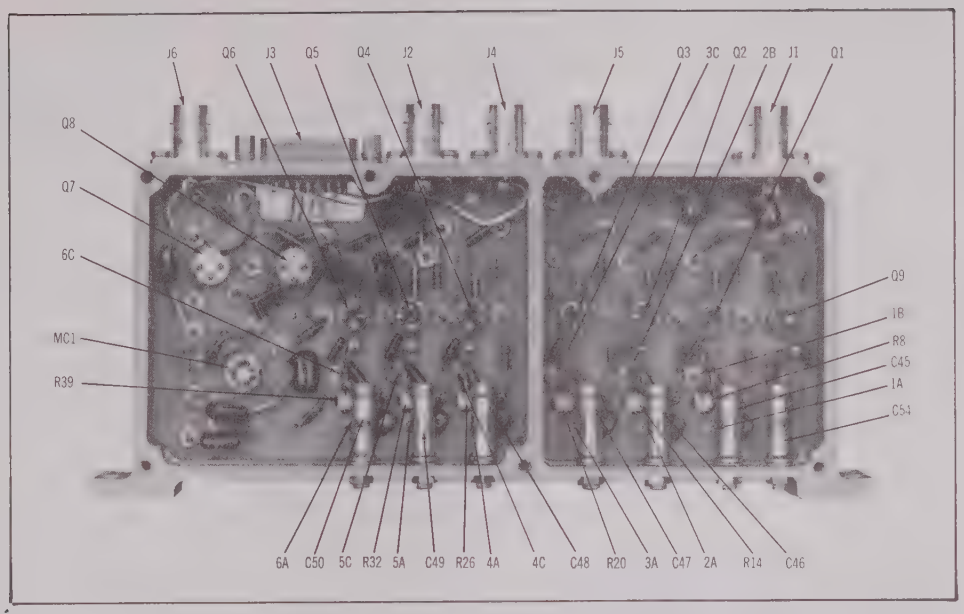


Figure 4-29. 60-MHz Logarithmic I-f Amplifier A221

and C23 (test point 4B). Adjust R26 to obtain a vom indication of 2200 ohms.

f. Connect the + lead of the vom to the junction of L14 and L17 (test point 5A in figure 4-29) and connect the common lead to the junction of R32 and C28 (test point 5B). Adjust R32 to obtain a vom indication of 2200 ohms.

g. Connect the + lead of the vom to the junction of L17 and R40 (test point 6A in figure 4-29) and connect the common lead to the junction of R39 and C34 (test point 6B). Adjust R39 to obtain a vom indication of 3000 ohms.

h. Remove the vom and replace the cover plate on that side of the amplifier which the tuning capacitors are located.

i. Energize the EMA-910 and allow the one minute delay period to elapse.

j. Disconnect W211P1 from A221J5 and connect the positive lead of an HP 410C voltmeter (set to the +1.5 volt range) to the center conductor of A221J5. Connect the voltmeter common lead to amplifier ground.

k. Tune an HP 608C signal generator to 60 MHz and adjust for a cw output. Couple the signal generator to A221J1 and increase the generator output level to obtain a voltmeter indication of 1.0 volts.

l. Adjust, in sequence, C50, C49, C48, C47, C46 and C45 to maximize the voltmeter indication. Adjust the signal generator output level, as required, to maintain a voltmeter indication between 1.0 and 1.5 volts.

m. Repeat step l.

n. Interconnect the equipment as illustrated in figure 4-30. Adjust the sweep generator center frequency to 60 MHz and adjust for a sweep width of at least 20 MHz. Set the sweep generator step attenuator to 60 dB and adjust the HP 355C attenuator for 3 dB insertion. Set the oscilloscope vertical and horizontal sensitivities to 1 volt/centimeter. Adjust the sweep generator output level to obtain an oscilloscope display having a maximum amplitude of 1 centimeter. Adjust the signal generator (set for a 60-MHz cw output) level to obtain a convenient marker display.

o. Reduce the sweep generator attenuation, in 10-dB steps, to 0 dB. Note the shift, if any, of the amplifier bandpass response. Alternately adjust C50, C49 and C48, as required, to obtain a symmetrical bandpass response.

p. Disconnect the equipment from the test setup of figure 4-30. Connect W208P2 to A221J1. Disconnect W215P2 from Z203J1 and connect the HP 608C signal generator (still tuned to 60 MHz) to Z203J1 through an HP 355D attenuator. Connect an HP 410D voltmeter to A221J5 (see step j) and set the voltmeter to the +1.5 volt range. Adjust the signal generator for a 0 dBm cw output and set the attenuator for 60 dB insertion. Set the BANDWIDTH switch to 5 MHZ and adjust R39, if necessary, to obtain a voltmeter indication of 1.20 volts.

q. Set the voltmeter to the +5 volt range and adjust the attenuator for 50 dB insertion. Adjust R32, if necessary, to obtain a voltmeter indication of 2.20 volts.

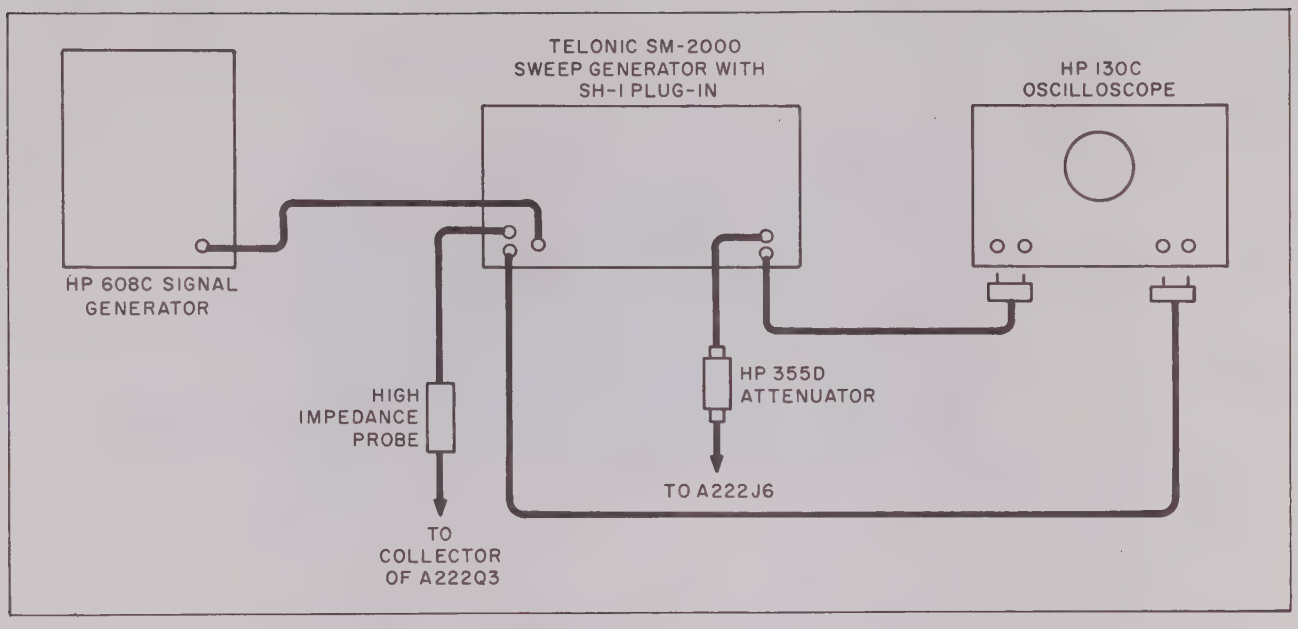


Figure 4-30. Alignment of 60-MHz Logarithmic I-f Amplifier A221, Equipment Setup

r. Set the attenuator for 40 dB insertion and adjust R26, if necessary, to obtain a voltmeter indication of 3.20 volts.

s. Set the attenuator for 30 dB insertion and adjust R20, if necessary, to obtain a voltmeter indication of 4.20 volts.

t. Set the voltmeter to the +15 volt range and set the attenuator for 20 dB insertion. Adjust R14, if necessary, to obtain a voltmeter indication of 5.20 volts.

u. Set the attenuator for 10 dB insertion and adjust R8, if necessary, to obtain a voltmeter indication of 6.20 volts.

v. Set the attenuator for 60 dB insertion, set the voltmeter to the +1.5 volt range and, if necessary, re-adjust R39 to obtain a voltmeter indication of 1.20 volts.

w. Repeat steps q through u.

x. De-energize the EMA-910 and disconnect the equipment. Replace the remaining cover plate. Connect W215P2 to Z203J1, connect W211P1 to A221J5 and replace A221 into the Data Evaluation Unit.

4-34. 60-MHZ LINEAR I-F AMPLIFIER A220, ALIGNMENT. To align the 60-MHz linear i-f amplifier, proceed as directed in the following steps.

a. With the EMA-910 unenergized, remove the four screws that secure A220 to the Data Evaluation Unit shelf and carefully withdraw the amplifier. Place a sheet of cardboard over the top of the Data Evaluation Unit and rest A220 on the cardboard.

b. Disconnect W213P2 from A220J1.

c. Energize the EMA-910 and allow the one minute delay period to elapse.

d. Tune an HP 608C signal generator to 60 MHz and adjust for a cw output level of -45 dBm and couple the signal to A220J1.

e. Set the ANALYSIS MODE switch to RMS, set the BANDWIDTH switch to FULL and adjust the IF GAIN control to obtain a mid-scale output meter pointer deflection.

f. Alternately adjust C19, C26 and C21 (see figure 4-31). Reduce the signal generator level, if necessary, to maintain an on-scale output meter indication.

g. Repeat step f until optimum response is obtained.

h. De-energize the EMA-910, disconnect the signal generator, replace A220 and connect W213P2 to A220J1.

4-35. 240/60-MHZ MIXER A225, ALIGNMENT. To align the mixer, proceed as directed in the following steps.

a. With the EMA-910 unenergized, lift A225 from the Data Evaluation Unit and place on a sheet of cardboard.

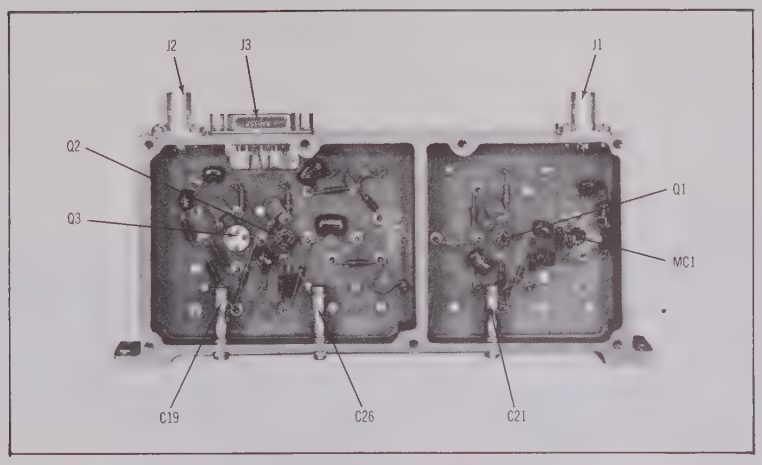


Figure 4-31. 60-MHz Linear I-f Amplifier A220

b. Connect a clip lead between the mixer housing and Data Evaluation Unit ground.

c. Energize the EMA-910.

d. Tune an HP 608C signal generator to 240 MHz and adjust for a cw output of -47 dBm. Couple the signal to A225J3.

e. Set the ANALYSIS MODE switch to RMS, set the BANDWIDTH switch to FULL, set the MULTIPLIER switch to $X10^0$ +0 DB and adjust the IF GAIN control to obtain a mid-scale output meter indication.

f. Adjust L3 (see figure 4-32) to obtain a maximum output meter indication. Reduce the signal generator output level, if necessary, to obtain optimum response.

g. De-energize the EMA-910, disconnect the signal generator and replace A225 into the Data Evaluation Unit.

4-36. CRYSTAL-CONTROLLED OSCILLATOR A226, ALIGNMENT. To align the crystal-controlled oscillator, proceed as follows.

a. With the EMA-910 unenergized, withdraw A226 and place the oscillator on a sheet of cardboard.

b. Energize the EMA-910.

c. Tune an HP 608C signal generator to 240 MHz and adjust for a cw output level of -47 dBm. Couple the signal generator to the Data Evaluation Unit rear panel 240 MHZ INPUT connector.

d. Set the BANDWIDTH switch to FULL, the ANALYSIS MODE switch to RMS, the MULTIPLIER switch to $X10^0$ +0 DB and adjust the IF GAIN control to obtain an output meter indication of 85 on the -DBM scale.

e. Alternately adjust L3, L4 and L5 (see figure 4-33) to obtain a maximum output meter indication. Should the output meter pointer deflect offscale before reading a maximum, reduce the signal generator level and continue adjustment of L3, L4 and L5.

4-37. OUTPUT METER CALIBRATION PROCEDURE.

4-38. To calibrate the output meter, proceed as directed in the following steps.

a. Connect the positive lead of an HP 3440A/3441A Digital Voltmeter (set to the +10 volt range) to pin 1 of X-Y connector J258. Connect the common lead to pin 6 (ground). Energize the EMA-910 and allow sufficient time for warmup.

b. Set the METER RESPONSE switch to ZERO and adjust the METER ZERO screwdriver control to obtain a voltmeter indication of 0 volts.

c. Set the METER RESPONSE switch to FAST and set the ANALYSIS MODE switch to SLIDEBACK. Adjust the SLIDEBACK THRESHOLD control to obtain a voltmeter indication of exactly 4.00 volts.

d. Adjust screwdriver control A235R3 (see figure 4-34) to obtain an output meter pointer indication of exactly 40 on the DB ABOVE 1 MICROVOLT scale.

e. Set the ANALYSIS MODE switch to PEAK, set the PEAK HOLD switch to 5 SEC and rotate the PEAK HOLD control fully clockwise to CAL.

f. Adjust a Wavetek 110 Function Generator for a 0.1-Hz square-wave output and set for minimum output level.

g. Disconnect W211P2 from A223J2 and connect the function generator to A223J2.

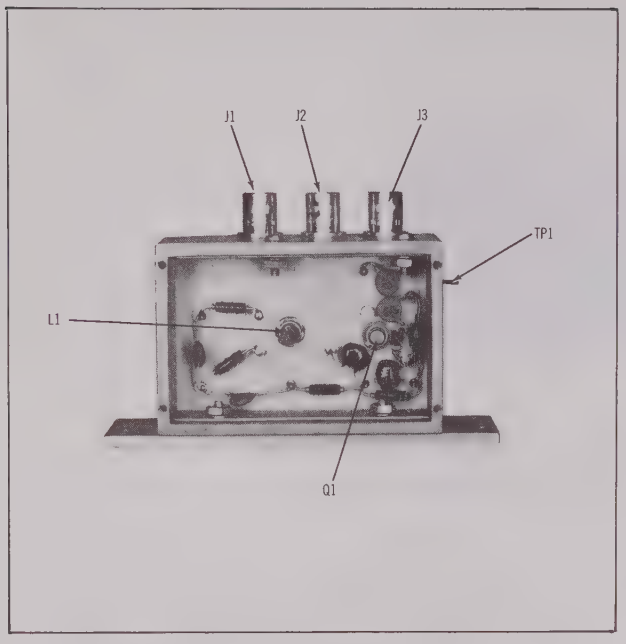


Figure 4-32. 240/60-MHz Mixer A225

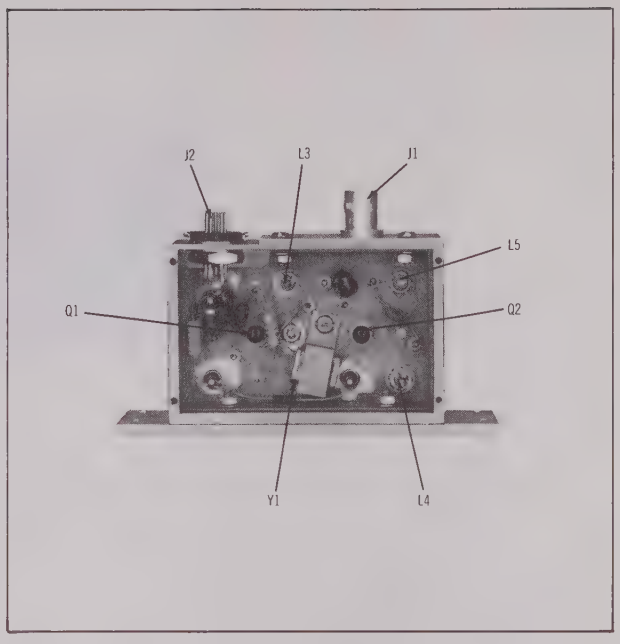


Figure 4-33. Crystal-Controlled Oscillator A226

h. Increase the function generator output level to obtain an output meter pointer indication of approximately 30 on the DB ABOVE 1 MICROVOLT scale.

i. Adjust screwdriver control A235R6 (see figure 4-34) to obtain an output meter pointer deflection dropping rate of 0.5 dB/5 seconds.

j. Set the function generator for a triangular-wave output at 0.01 Hz and set the PEAK HOLD switch to .01 SEC.

k. Adjust screwdriver control A235R4 (see figure 4-34) so that the output meter pointer deflection decreases in 1-dB increments during the falling part of the triangular wave.

l. Disconnect the function generator and connect W211P2 to A223J2.

m. Connect an HP608C Signal Generator (tuned to 240 MHz and adjusted for a cw output level of -47 dBm) to the Data Evaluation Unit rear panel 240 MHZ INPUT connector.

n. Set the BANDWIDTH switch to 0.5 MHZ, set the MULTIPLIER switch to $X10^0$ +0 DB and set the ANALYSIS MODE switch to RMS. Set the IF GAIN control to mid-range and carefully adjust the signal generator frequency to obtain a maximum output meter pointer deflection. Re-adjust the signal generator output level, if necessary, at -47 dBm and adjust the IF GAIN control to obtain an output meter pointer indication of 40 on the DB ABOVE 1 MICROVOLT scale.

o. Set the BANDWIDTH switch to 1 MHZ and adjust the signal generator frequency (while maintaining its output level constant at -47 dBm) to obtain a maximum output meter pointer deflection.

p. Adjust 1 MHz screwdriver control R226 (see figure 4-34) to obtain an output meter pointer indication of exactly 40 on the DB ABOVE 1 MICROVOLT scale.

q. Set the BANDWIDTH switch to 5 MHZ and adjust the signal generator frequency (while maintaining its output level constant at -47 dBm) to obtain a maximum output meter pointer deflection.

r. Adjust 5 MHz screwdriver control R227 (see figure 4-34) to obtain an output meter pointer indication of exactly 40 on the DB ABOVE 1 MICROVOLT scale.

s. Set the BANDWIDTH switch to FULL and adjust the signal generator frequency (while maintaining its output level constant at -47 dBm) to obtain a maximum output meter pointer deflection.

t. Adjust Full screwdriver control R228 (see figure 4-34) to obtain an output meter pointer indication of exactly 40 on the DB ABOVE 1 MICROVOLT scale.

u. Set the BANDWIDTH switch to 1 MHZ, set the MULTIPLIER switch to $X10^1$ +20 DB and increase the signal generator output level to -27 dBm. Carefully adjust the signal generator frequency (while maintaining its output level constant at -27 dBm) to obtain a maximum output meter pointer deflection. Re-adjust the IF GAIN control, if necessary, to maintain an on-scale output meter indication.

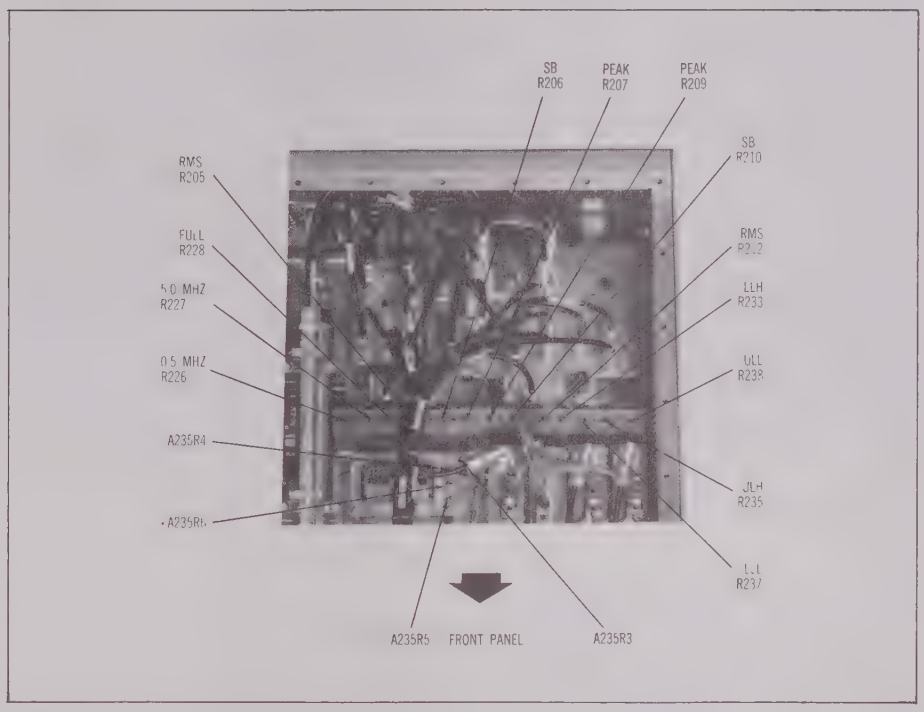


Figure 4-34. Metering Circuitry Controls

v. Connect the positive lead of the voltmeter to the center conductor of the front panel VIDEO connector. Keep the common lead connected to ground at J258-6.

w. Adjust the IF GAIN control to obtain a voltmeter indication of exactly 5.20 volts.

x. Adjust RMS screwdriver control R205 (see figure 4-34) to obtain an output meter pointer indication of exactly 40 on the DB ABOVE 1 MICROVOLT scale.

y. Decrease the signal generator output level to -67 dBm and adjust RMS screwdriver control R212 (see figure 4-34) to obtain an output meter pointer indication of exactly 0 on the DB ABOVE 1 MICROVOLT scale.

z. Increase the signal generator output level to -27 dBm.

aa. Repeat steps x through z until no further adjustment of either screwdriver control is required to obtain the specified output meter indications.

ab. Adjust the signal generator output level to -27 dBm and set the ANALYSIS MODE switch to SLIDEBACK. Adjust the SLIDEBACK THRESHOLD control to obtain an output meter pointer indication of exactly 40 on the DB ABOVE 1 MICROVOLT scale.

ac. Adjust SB screwdriver control R206 (see figure 4-34), if necessary, until the SLIDEBACK INDICATOR lamp just begins to glow.

ad. Decrease the signal generator output level to -47 dBm and adjust the SLIDEBACK THRESHOLD control to obtain an output meter pointer indication of exactly 20 on the DB ABOVE 1 MICROVOLT scale.

ae. Adjust SB screwdriver control R210 (see figure 4-34) until the SLIDEBACK INDICATOR lamp just begins to glow.

af. Set the signal generator output level to -27 dBm.

ag. Repeat steps ac through af until no further adjustment of either screwdriver control is required to obtain the specified indications.

ah. Adjust the signal generator for a -27 dBm output and set the ANALYSIS MODE switch to PEAK.

ai. Adjust Peak screwdriver control R207 (see figure 4-34) to obtain an output meter pointer indication of 40 on the DB ABOVE 1 MICROVOLT scale.

aj. Reduce the signal generator output level to -47 dBm and adjust Peak screwdriver control R209 (see figure 4-34) to obtain an output meter pointer indication of 20 on the DB ABOVE 1 MICROVOLT scale.

ak. Increase the signal generator output level to -27 dBm.

al. Repeat steps ai through ak until no further adjustment of either screwdriver control is required to obtain the specified output meter indications.

am. Disconnect the test equipment.

4-39. AFC CIRCUITRY ALIGNMENT PROCEDURES.

4-40. The procedures for aligning the afc circuits are contained in paragraphs 4-41 through 4-43.

4-41. 60-MHZ I-F AMPLIFIER/AFC DISCRIMINATOR A222, ALIGNMENT. To align this assembly, proceed as directed in the following steps.

a. With the EMA-910 unenergized, withdraw A222 from the Data Evaluation Unit. Connect the equipment as illustrated in figure 4-35.

b. Adjust the sweep generator for an output centered at 60 MHz, a sweep width of approximately 20 MHz and adjust for minimum output level. Tune the signal generator for a cw output at 60 MHz.

c. Energize the equipment and allow sufficient time for warmup.

d. Increase the sweep generator output level to obtain a convenient oscilloscope display. Note that, as the sweep generator output level is increased beyond a critcial value, limiting will occur. Adjust the sweep generator output level to approximately 6-10 dB below the limiting level.

e. Alternately adjust C27, C28 and C30 (see figure 4-36) to obtain a symmetrical oscilloscope display having a maximum amplitude at 60 MHz. Should limiting occur as these adjustments are being made, decrease the sweep generator output level.

f. Remove the high impedance probe and replace the two cover plates to the amplifier.

g. Couple A222J2 directly to the sweep generator "marker adder in" connector.

h. Increase the sweep generator output level by approximately 20 dB.

i. Alternately adjust L9, C36, L10 and C37 to obtain a discriminator output similar to that illustrated in figure 4-37.

j. Reduce the sweep generator sweep width and adjust R48 so that the 60 MHz marker is at 0 volts.

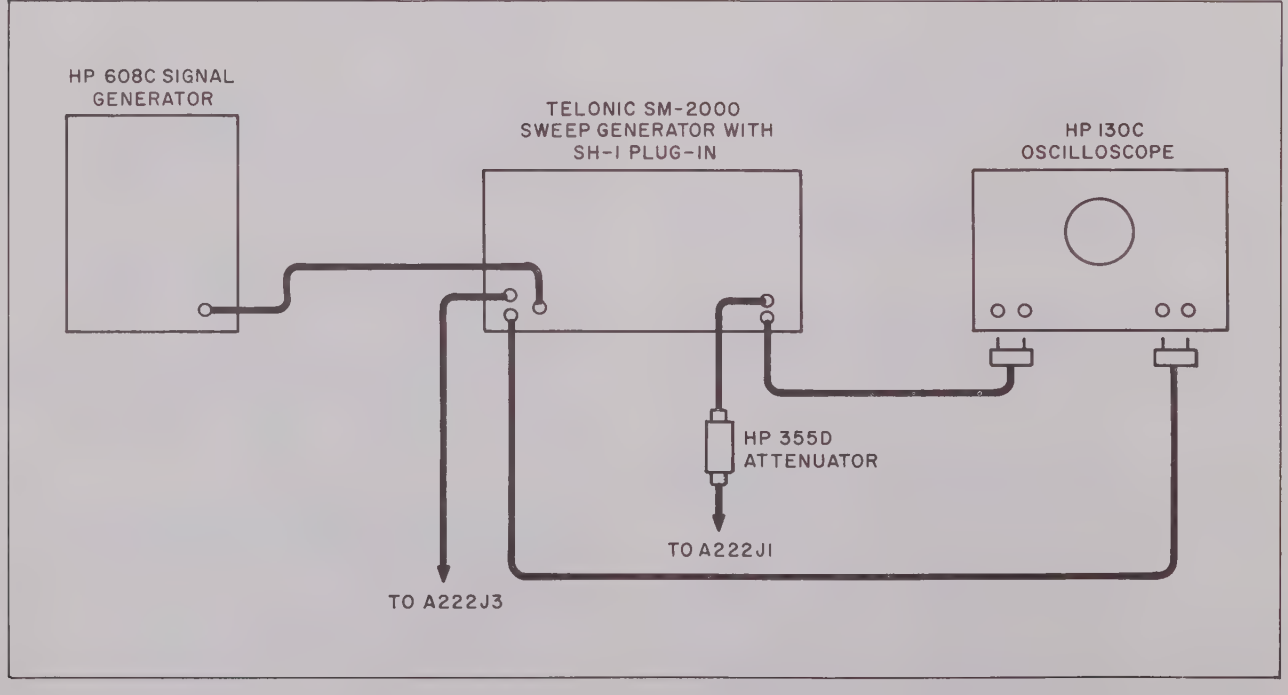


Figure 4-35. Alignment of 60-MHz I-f Amplifier/Afc Discriminator A222, Equipment Setup

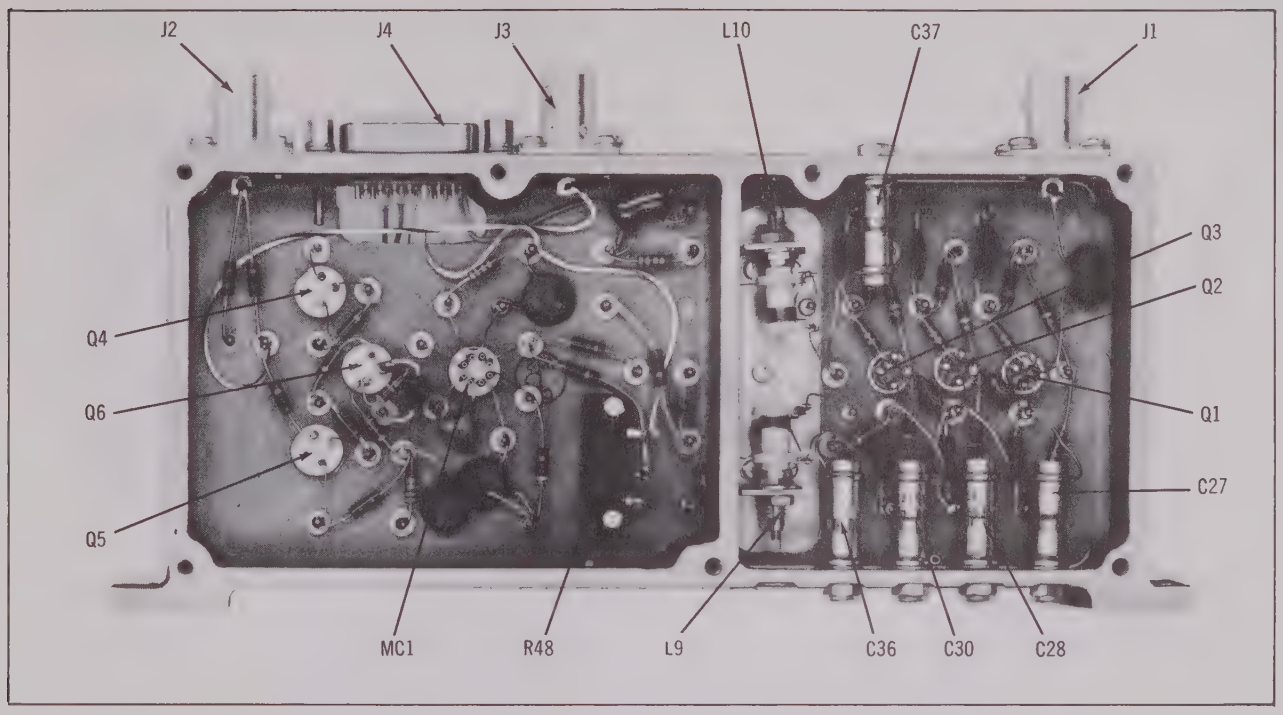


Figure 4-36. 60-MHz I-f Amplifier/Afc Discriminator A222

k. De-energize the equipment and replace A222 into the Data Evaluation Unit.

4-42. AFC PULSE AMPLIFIER A101, ALIGNMENT. To align the afc pulse amplifier (see figure 4-38), proceed as follows.

a. Connect an HP 608C signal generator (tuned to 60 MHz and adjusted for minimum output level) to A221J1.

b. Withdraw A101 from its mating receptacle, install extender board 80362-7 into J101 and then mount A101 atop the extender board.

c. Connect an oscilloscope to A101-11.

d. Energize the EMA-910.

e. Increase the signal generator output level until the output meter pointer deflects to a full-scale indication.

f. Tune the signal generator to each side of 60 MHz to establish the maxima of the discriminator "S" curve.

g. Adjust R2 to obtain a pulse amplitude of 8 volts at the positive and negative maxima.

4-43. BALANCING AFC OPERATIONAL AMPLIFIER A115. To balance afc operational amplifier A115, proceed as directed in the following steps.

a. With the EMA-910 unenergized, couple the Frequency Selection Unit to the Data Evaluation Unit using the supplied power patch cable.

b. Remove the screw (and bracket) that secures afc operational amplifier A115 (see figure 4-9). Carefully withdraw A115 and short terminals 1, 2 and 7 together.

c. Connect a voltmeter between terminals 5 and 7 and partially insert A115 into its mating receptacle.

d. Energize the EMA-910 and allow the one minute delay period to elapse.

e. Adjust screwdriver control R108 (see figure 4-9) to obtain a voltmeter indication of 0 volts.

Note

It will be very difficult to obtain exactly 0 volts by adjustment of R108. The proper setting of R108 is that point at which the output of the difference amplifier output voltage snaps from one extreme value to another (i.e., from +10 to -10 volts or from -10 to +10 volts).

f. De-energize the EMA-910.

g. Withdraw A115 and remove the short installed in step b.

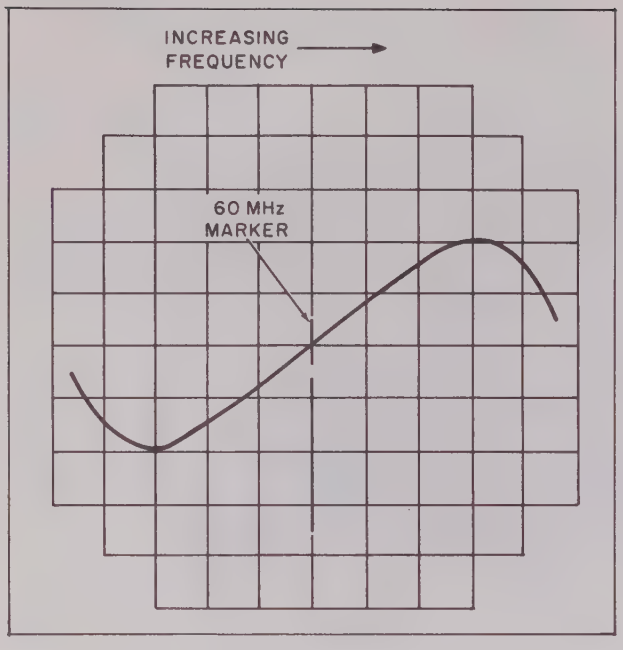


Figure 4-37. Discriminator Output Characteristics

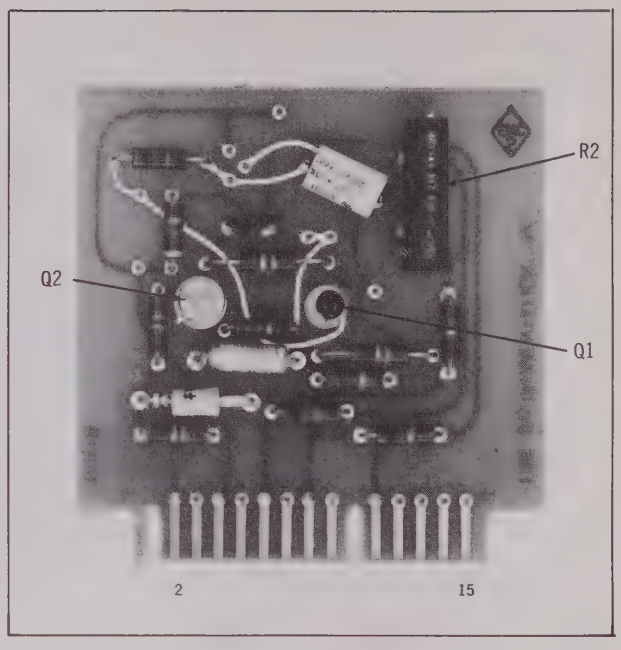


Figure 4-38. Afc Pulse Amplifier A101

h. Replace A115 into the Frequency Selection Unit.

4-44. SCANNING CIRCUITRY REPLACEMENT AND ALIGNMENT PROCEDURES.

4-45. The procedures for replacing the tuner dual tracking potentiometer and limit microswitches are detailed in paragraphs 4-46 and 4-47, respectively. The procedures for calibrating the x analog output voltage and scan frequency limits are presented in paragraphs 4-48 and 4-49, respectively.

4-46. REPLACEMENT OF TUNER DUAL TRACKING POTENTIOMETER. To replace the tuner dual tracking potentiometer, proceed as directed in the following steps.

a. With the EMA-910 unenergized, remove the tuner from the Frequency Selection Unit as detailed in paragraph 4-25.

b. Unsolder the six wires from the dual potentiometer terminals.

c. Mount a knob on the tuning drive shaft and rotate the knob fully counterclockwise.

d. Loosen the setscrew on the gear behind the antibacklash spring drum. Access to this setscrew can be gained through the opening in the tuner casting near the high limit microswitch.

e. Rotate the knob clockwise until the second setscrew on the gear is accessible. Loosen this setscrew.

f. Loosen the setscrew on the antibacklash spring drum and unwrap the end of the coil spring from its retaining screw. Release the spring slowly and remove the antibacklash spring drum.

g. Using a long-handled screwdriver, loosen the three clamp screws which secure the dual potentiometer to the phenolic block.

h. Grasp the potentiometer and remove from the tuner. Watch for a falling gear.

i. Mount a replacement potentiometer on the shaft. Note that, if the gear came out in step h, first mount the gear (hub toward casting) and then insert the potentiometer.

j. Orient the potentiometer so that the terminals face the top of the tuner. Tighten the three clamp screws.

k. Rotate the knob fully counterclockwise.

l. Connect a Simpson 260 VOM (set to the RX100 range) between the center and CW terminals of the 100K section of the dual potentiometer.

m. Adjust the potentiometer shaft to obtain an ohmmeter indication of 1000 ohms.

n. Orient the gear so that one of its setscrews is accessible through the hole in the casting. Slide the gear toward the front of the tuner until it engages its mating gear and then hits bushing. Tighten the setscrews.

o. Rotate the knob fully clockwise and check that the ohmmeter still reads 1000 ohms. If it does not, repeat steps d, e, m and n.

p. Mount the antibacklash spring drum on the shaft.

q. Rotate the knob fully clockwise.

r. Hook the end of the antibacklash coil spring onto the retaining screw.

s. Rotate the antibacklash spring drum counterclockwise to increase the tension on the coil spring. After the drum has been rotated fully counterclockwise, back off 1/2-turn and, while holding the drum fixed in this position, tighten the drum setscrew.

t. Remove the ohmmeter.

u. Solder the leads to the proper potentiometer terminals.

v. Align the local oscillator (refer to paragraph 4-15) and calibrate the x analog output voltage (refer to paragraph 4-48).

4-47. REPLACEMENT OF TUNER LIMIT MICROSWITCHES. To replace a limit microswitch, proceed as directed in the following steps.

a. With the EMA-910 unenergized and the tuner removed from the Frequency Selection Unit, mount a knob on the tuning drive shaft.

b. Adjust the knob so that the microswitch actuator clears the lever arm of the microswitch to be replaced.

c. When replacing the high limit microswitch, remove the two mounting screws (accessible from the top of the tuner) and withdraw the microswitch. When replacing the low limit microswitch, first remove the two screws which secure the switch/mounting block to the tuner casting. Withdraw the switch/mounting block.

d. Unsolder the wires from the switch terminals.

e. Solder the wires to the terminals of the replacement microswitch. Install the replacement switch into the tuner.

f. If the high limit microswitch was replaced, rotate the knob fully clockwise and then back off until the high frequency limit scribe mark is under the index pointer. Carefully bend the microswitch lever arm so that the switch is actuated somewhere between this setting of the tuning shaft and the extreme clockwise setting.

g. If the low limit microswitch was replaced, rotate the knob fully counterclockwise and then back off until the low frequency limit scribe mark is under the index pointer. Carefully bend the microswitch lever arm so that the switch is actuated somewhere between this setting of the tuning shaft and the extreme counterclockwise setting.

4-48. X ANALOG OUTPUT VOLTAGE CALIBRATION. To calibrate the x analog output voltage, proceed as directed in the following steps.

a. With the Data Evaluation Unit connected to the Frequency Selection Unit, set the SWEEP MODE switch to MANUAL, set the BAND SWITCH switch to BAND 1 and connect the positive lead of an HP 3440A/3441A Digital Voltmeter (set to the +100 volt range) to pin 4 of X-Y connector J258. Connect the common lead of the voltmeter to J258-6.

b. Remove the screw (and bracket) that secures X analog operational amplifier A219 (see figure 4-7) to A235. Carefully withdraw A219 and, using a short length of hook-up wire, short terminal 1 to terminal 7. Replace the operational amplifier.

c. Adjust screwdriver control A235R5 (see figure 4-39) to obtain a voltmeter indication of 0 volts.

d. Withdraw A219, remove the short between terminals 1 and 7 and replace the operational amplifier. Secure A219 to A235 with the screw and bracket removed in step b.

e. Adjust the band 1 tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of exactly 1.10. Adjust screwdriver control A105R3 to obtain a voltmeter indication of exactly 1.10 volts.

f. Adjust the band 1 tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of exactly 2.40. Adjust screwdriver control A105R2 to obtain a voltmeter indication of exactly 2.40 volts.

g. Repeat steps e and f until no further adjustment of either screwdriver control is required to obtain the specified voltmeter indications.

h. Set the BAND SWITCH switch to BAND 2.

i. Adjust the band 2 tuning control to obtain a BAND 2 2.4-4.4 GHZ indicator reading of exactly 2.50. Adjust screwdriver control A105R8 to obtain a voltmeter indication of exactly 2.50 volts.

j. Adjust the band 2 tuning control to obtain a BAND 2 2.4-4.4 GHZ indicator reading of exactly 4.30. Adjust screwdriver control A105R6 to obtain a voltmeter indication of exactly 4.30 volts.

k. Repeat steps i and j until no further adjustment of either screwdriver control is required to obtain the specified voltmeter indications.

l. Set the BAND SWITCH switch to BAND 3.

m. Adjust the band 3 tuning control to obtain a BAND 3 4.3-7.3 GHZ indicator reading of exactly 4.40. Adjust screwdriver control A105R13 to obtain a voltmeter indication of exactly 4.40 volts.

n. Adjust the band 3 tuning control to obtain a BAND 3 4.3-7.3 GHZ indicator reading of exactly

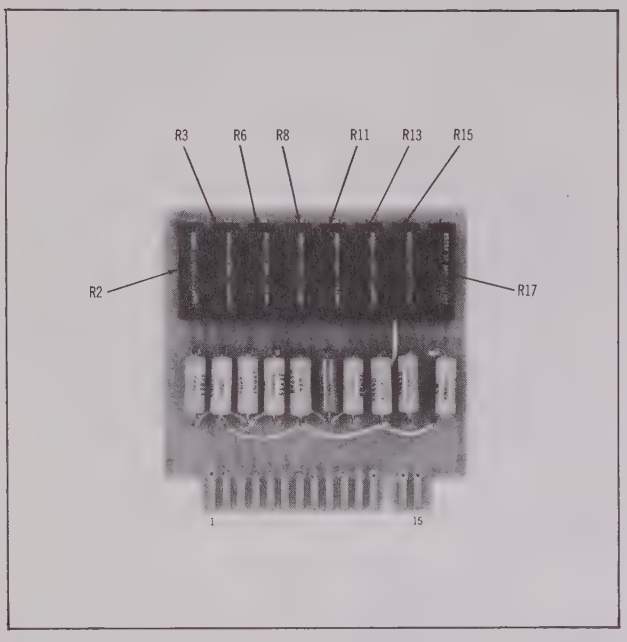


Figure 4-39. X Analog Voltage Tracking Adjustments A105

7.20. Adjust screwdriver control A105R11 to obtain a voltmeter indication of exactly 7.20 volts.

o. Repeat steps m and n until no further adjustment of either screwdriver control is required to obtain the specified voltmeter indications.

p. Set the BAND SWITCH switch to BAND 4.

q. Adjust the band 4 tuning control to obtain a BAND 4 7.2-10.5 GHZ indicator reading of exactly 7.30. Adjust screwdriver control A105R17 to obtain a voltmeter indication of exactly 7.30 volts.

r. Adjust the band 4 tuning control to obtain a BAND 4 7.2-10.5 GHZ indicator reading of exactly 10.40. Adjust screwdriver control A105R15 to obtain a voltmeter indication of exactly 10.40 volts.

s. Repeat steps q and r until no further adjustment of either screwdriver control is required to obtain the specified voltmeter indications.

4-49. SCAN LIMIT FREQUENCY CALIBRATION. To calibrate the limit frequencies for the single and continuous sector scan modes of operation, proceed as directed in the following steps.

a. With the Data Evaluation Unit connected to the Frequency Selection Unit, set the BAND SWITCH switch to BAND 1, set the SWEEP MODE switch to SECTOR, set the SWEEP RATE switch to SLOW and rotate the SWEEP RATE control fully clockwise. Adjust the LOWER LIMIT control to obtain an indication of 1.20 and adjust the UPPER LIMIT control to obtain an indication of 1.40.

b. Rotate the band 1 tuning control fully counterclockwise.

c. Momentarily depress the SWEEP START pushbutton switch; the band 1 tuner should start to sweep up frequency. If the CROSSOVER indicator lamp flashes, the sweep will not begin when the SWEEP START pushbutton switch is depressed. Should this occur, adjust the setting of ULL screwdriver control R238 (see figure 4-34) until the CROSSOVER indicator lamp ceases flashing and again depress the SWEEP START pushbutton switch.

d. Alternately adjust LLL and ULL screwdriver controls R237 and R238, respectively (see figure 4-34) until the band 1 tuner reverses its scan direction at BAND 1 1-2.5 GHZ indicator readings of 1.20 and 2.40.

e. Set the SWEEP MODE switch to MANUAL and set the BAND SWITCH switch to BAND 4.

f. Rotate the band 4 tuning control fully counterclockwise, adjust the LOWER LIMIT control to obtain an indication of 10.20 and adjust the UPPER LIMIT control to obtain an indication of 10.40.

g. Momentarily depress the SWEEP START pushbutton switch; the band 4 tuner should start to sweep up-frequency. If the CROSSOVER indicator lamp flashes, the sweep will not begin when the SWEEP START pushbutton switch is depressed. Should this occur, adjust the setting of ULH screwdriver control R223 (see figure 4-34) until the CROSSOVER indicator lamp no longer flashes and again depress the SWEEP START pushbutton switch.

h. Alternately adjust ULH and LLH screwdriver controls R235 and R223, respectively (see figure 4-34) until the band 4 tuner reverses its scan direction at BAND 4 7.2-10.5 GHZ indicator readings of 10.20 and 10.40.

i. Repeat steps b through h until no further adjustment of any screwdriver control is required to obtain the specified scan direction reversal points.

4-50. REVISING GAIN CALIBRATION AND DATA NORMALIZATION CURVES.

4-51. After any r-f circuit component (such as the klystron local oscillator, preselector, preamplifier, impulse generator, etc.) has been replaced and/or aligned, new data must be taken so that new gain calibration and data normalization curves can be drawn.

4-52. GAIN CALIBRATION CURVE. To obtain a new gain calibration curve, proceed as directed in the following steps.

a. Interconnect the Frequency Selection Unit and the Data Evaluation Unit by means of the supplied power and i-f patch cables.

b. Energize the EMA-910 and allow at least two hours for warmup.

c. Set the ANALYSIS MODE switch to PEAK, set the PEAK HOLD switch to .01 SEC, rotate the PEAK HOLD control fully clockwise to CAL and set the SWEEP MODE switch to MANUAL. Set the AFC switch to OFF, set the BANDWIDTH switch to 5 MHZ, set the MULTIPLIER switch to $X10^4$ +80 DB and set the IF GAIN control to mid-range.

d. Set the BAND SWITCH switch to that position corresponding to the tuning band in which the repair and/or alignment has been made. Note that, if a r-f component common to all four bands has been replaced (such as the impulse generator), new calibration data must be taken for all four tuning bands and the BAND SWITCH should be set to BAND 1.

e. Adjust the appropriate tuning control to obtain a digital frequency indication corresponding to the low end of the selected band.

f. Couple a microwave signal generator to the RF INPUT connector as illustrated in figure 4-2b. Tune the signal generator to the frequency the EMA-910 is tuned and adjust the generator for a cw output level of approximately 0 dBm.

g. Carefully adjust the signal generator frequency to obtain a maximum output meter pointer deflection. If the output meter pointer deflects off-scale before reaching a maximum, rotate the IF GAIN control counterclockwise and repeat the above.

h. Without further adjustment of the signal generator frequency, couple the signal generator to a power meter as illustrated in figure 4-2a and adjust the generator output level to obtain a power meter indication of exactly 0 dBm.

i. Reconnect the signal generator as illustrated in figure 4-2b.

j. Carefully adjust the IF GAIN control to obtain an output meter indication of exactly 80 on the -DBM scale.

k. Without further adjustment of the IF GAIN control, depress the CALIBRATE pushbutton switch and note the output meter indication on the DB ABOVE 1 MICROVOLT scale. Record this value on the replacement gain calibration curve (figure 2-4 printed on blue paper and located at the end of this section). Note that the revised gain calibration curve is printed on blue paper to signify that the equipment has been recalibrated and that the original factory gain calibration curve is no longer valid.

l. Release the CALIBRATE pushbutton switch after the output meter pointer deflection has been recorded.

m. Repeat steps f through l, in 100-MHz increments, throughout the band of the tuner or throughout the 1.0 - 10.5 GHz range, as governed by the nature of the repair and/or alignment made.

n. After all the data has been obtained, plot a revised gain calibration curve and incorporate the new curve into Section II.

o. Proceed to paragraph 4-53.

4-53. DATA NORMALIZATION CURVE. After a new gain calibration curve has been prepared, proceed as directed in the following steps to obtain a revised data normalization curve.

a. Set the BAND SWITCH switch to BAND 1 and adjust the band 1 tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of 1.00.

b. Couple a microwave signal generator to the RF INPUT connector as illustrated in figure 4-2b. Tune the signal generator to 1.00 GHz and adjust for a cw output level of approximately 0 dBm.

c. Carefully adjust the generator frequency to obtain a maximum output meter pointer deflection. If the output meter pointer deflects to an off-scale indication before reaching a maximum, reset the IF GAIN control.

d. Without further adjustment of the signal generator frequency, couple the generator to a power meter as illustrated in figure 4-2a. Adjust the generator output level to obtain a power meter indication of exactly 0 dBm.

e. Reconnect the signal generator as illustrated in figure 4-2b.

g. Carefully adjust the IF GAIN control to obtain an output meter indication of exactly 80 on the -DBM scale. Do NOT adjust the setting of the IF GAIN control during the remainder of this procedure.

g. Adjust the tuning control to obtain a BAND 1 1-2.5 GHZ indicator reading of 1.10.

h. Tune the signal generator to obtain a maximum output meter indication.

i. Connecf the signal generator as illustrated in figure 4-2a and adjust the generator output level to obtain a power meter indication of exactly 0 dBm.

j. Connect the generator as shown in figure 4-2b and note the output meter indication on the -DBM scale. If the output meter reads to the left of 80, subtract 80 from the reading and enter the difference as a positive (+) correction factor in the replacement data normalization curve at the rear of this section. If the output meter reads to the right of 80, subtract this reading from 80 and enter the difference as a negative (-) correction factor in the replacement data normalization curve. Note that the replacement data normalization curve

(figure 2-9), like the replacement gain calibration curve, is printed on blue paper to signify that the original factory data is no longer valid.

k. Repeat step j, in 100-MHz increments, throughout the frequency range of the equipment.

l. After all data normalization points have been obtained, plot a new curve and incorporate the new curve into Section II.

m. De-energize the EMA-910 and disconnect the equipment.

4-54. VOLTAGE MEASUREMENTS.

4-55. Voltage measurements for all the assemblies referenced in the troubleshooting procedures are contained in tables 4-9 through 4-31. Note that all measurements were made with a vtvm with respect to equipment ground (except for tables 4-15 and 4-21).

TABLE 4-9. VOLTABE MEASUREMENTS, AFC PULSE AMPLIFIER A101

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3565	+2	+2.5	+11
Q2	40327	+1.4	+2	+75

TABLE 4-10. VOLTAGE MEASUREMENTS, 240-MHZ PREAMPLIFIERS A107, A108, A109 AND A110

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	A490	-11.5	-12	0
Q2	2N3563	-11.5	-12	0

TABLE 4-11. VOLTAGE MEASUREMENTS, AUDIO AMPLIFIER A201

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3567	-0.5	0	+24
Q2	2N3567	+6	+6.5	+18
Q3	2N1481	0	+0.5	+24
Q4	2N1481	0	+0.5	+24

TABLE 4-12. VOLTAGE MEASUREMENTS, +12/+24 VOLT REGULATOR A202

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3567	+13	+13.5	+18
Q2	2N3567	+12.5	+13	+18
Q3	2N3567	+5.7	+6.2	+12
Q4	2N3567	+5.7	+6.2	+13.5
Q5	2N3567	+24.5	+25	+36
Q6	2N3565	+12	+12.5	+25

TABLE 4-13. VOLTAGE MEASUREMENTS, -12/-24 VOLT REGULATOR A203

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3638	-24.5	-25	-36
Q2	2N3638A	-12	-12.5	-25
Q3	2N3638	-12.5	-13	-18
Q4	2N3638A	0	-0.5	-13

TABLE 4-14. VOLTAGE MEASUREMENTS, +27 VOLT REGULATOR A204

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3638	-0.25	-0.8	-4.5
Q2	2N3638	+11.5	+12	-0.8
Q3	2N3638	+11.5	+12	0

TABLE 4-15. VOLTAGE MEASUREMENTS, FLOATING ±28.5 VOLT REGULATOR A207

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3567	+29	+29.5	+35
Q2	2N3638	-29	-29.5	-35
Q3	2N3567	+13.5	+14	+29.5
Q4	2N3638	-13.5	-14	-29.5
Q5	2N3567	+5.7	+6.2	+24.5
Q6	2N3567	+5.7	+6.2	+13.5
Q7	2N3638	0	-0.5	-13.5

Note: Voltages measured with respect to terminal 15 with voltmeter input floating.

TABLE 4-16. VOLTAGE MEASUREMENTS, VOLTAGE COMPARATORS A208, A213, A214, A215 AND A216

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3569	+1.5	+2	+5
Q2	2N3569	+1	+1.5	+5
Q3	2N3569	+1	+1.2	+15
Q4	2N3569	+1.2	+1.5	+20
Q5	2N3638	+19	+20	0
Q6	2N3569	0	0	+24
Q7	2N3569	-12	-11.5	+1

Note: +2 volts at pin 2 and +1.5 volts at pin 14.

TABLE 4-17. VOLTAGE MEASUREMENTS, MEMORY CLEAR PULSE AMPLIFIER A209

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3565	-0.5	0	+12
Q2	2N3569	0	-0.5	0
Q3	2N3638A	0	0	-12

TABLE 4-18. VOLTAGE MEASUREMENTS, SLIDEBACK/VIDEO STRETCH AMPLIFIER A210

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3565	+0.5	+1	+12
Q2	2N3565	+0.5	0	+12
Q3	2N3638A	+12	+12	0
Q4	2N3565	0	0	+12
Q5	40327	0	0	+4
Q6	2N3565	-0.5	0	+12
Q7	2N3567	-1	-0.5	+12
Q8	2N3565	-0.5	0	+12

Note: +1 volt at pin 3 and pins 2 and 9 grounded.

TABLE 4-19. VOLTAGE MEASUREMENTS, AFC BIPOLAR PULSE STRETCHER A211

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3569	+1.5	+2	+12
Q2	2N3638A	-2	-1.5	-12
Q3	2N3565	+1	+1.5	+12
Q4	2N3565	+0.5	+1	+12
Q5	2N3638A	-1	-1.5	-12
Q6	2N3638A	-0.5	-1	-12

Note: Pin 2 grounded.

TABLE 4-20. VOLTAGE MEASUREMENTS, SCAN DIRECTION CONTROL FLIP-FLOP A212

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1*	2N3567	+0.5	-4.5	+18
Q2*	2N3567	+0.5	+1	+0.6
Q3*	2N3567	0	+0.25	+24
Q1**		+0.5	+1	+0.6
Q2**		+0.5	-4.5	+18
Q3**		0	+0.5	+0.1

* "Set" condition
** "Reset" condition

TABLE 4-21. VOLTAGE MEASUREMENTS, PEAK OPERATIONAL AMPLIFIER A217

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N1613	+0.65	+1.15	+24
Q2	2N1613	+0.15	+0.65	+23
Q3	2N1613	+0.5	+1	+24
Q4	2N1613	0	+0.5	+15
Q5	2N1613	0	+0.5	+0.15
Q6	2N1132	+1.5	+1	-28.5
Q7	FT2484	+2.5	+3	+24
Q8	2N1613	+23	+24	+28
Q9	2N1613	+22.5	+23	+28
Q10	2N1132	+22.5	+22	+1
Q11	2N657	+0.5	+1	+25.5
Q12	2N657	0	+0.5	+25.5

Notes: a. All voltages measured with respect to terminal 11 with floating voltmeter.
b. 100K resistor connected between pins 3 and 8.
c. 100K resistor connected between pins 8 and 13.
d. P246 disconnected from A223J4.
e. A235R6 adjusted for 0 volts at pin 3.

TABLE 4-22. VOLTAGE MEASUREMENTS, 60-MHZ LINEAR I-F AMPLIFIER A220

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3563	+5.5	+6	+12
Q2	2N3563	+5.5	+6	+12
Q3	2N2217	+5.5	+6	+24

		1	2	3	4	5	6	7	8	9	10
MC1		+0.5	0	0	+0.5	+3	+12	0	+3	+12	+3

Note: BANDWIDTH switch set to 0.5 MHz.

TABLE 4-23. VOLTAGE MEASUREMENTS, 60-MHZ LOGARITHMIC I-F AMPLIFIER A221

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3563	-6.5	-6	0
Q2	2N3563	-6.5	-6	0
Q3	2N3563	-6.5	-6	0
Q4	2N3563	-6.5	-6	0
Q5	2N3563	-6.5	-6	0
Q6	2N3563	-6.5	-6	0
Q7	2N697	0	+0.5	+12
Q8	2N3638	0	-0.5	-12
Q9	A490	-3.5	-3	0

		1	2	3	4	5	6	7	8
MC1	uA702	0	0	0	-5.6	+1	+0.5	0	+12

Note: Input cable disconnected.

TABLE 4-24. VOLTAGE MEASUREMENTS, 60-MHZ I-F AMPLIFIER/AFC DISCRIMINATOR A222

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3563	-12.5	-12	0
Q2	2N3563	-12.5	-12	0
Q3	2N3563	-12.5	-12	0
Q4	2N3567	0	+0.5	+12
Q5	2N3638	0	-0.5	-12
Q6	2N3638	0	-0.5	-12

		1	2	3	4	5	6	7	8
MC1	uA702	0	0	0	-5.6	+1	+0.5	0	+12

Note: Input cable disconnected.

TABLE 4-25. VOLTAGE MEASUREMENTS, VIDEO BUFFER/PEAK DRIVER AMPLIFIER A223

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3569	0	+0.5	+12
Q2	2N3638A	0	-0.5	-12
Q3	2N3569	0	0	+12
Q4	2N3565	0	0	+12
Q5	2N3565	0	+0.5	+0.2
Q6	2N3638A	+12	+12	-12
Q7	2N3569	-12	-12	+12
Q8	2N3565	-6	-5.5	-0.5

Notes: a. Input cables disconnected from A223J2 and A223J4
b. Apply +1 volt (through a 1K current limiting resistor) to base of Q5.

TABLE 4-26. VOLTAGE MEASUREMENTS, 240/60-MHZ MIXER A225

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	A490	+2.5	+3	+12

TABLE 4-27. VOLTAGE MEASUREMENTS, CRYSTAL-CONTROLLED OSCILLATOR A226

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3563	+3.5	+4	+12
Q2	2N3563	0	+0.5*	+12

* This voltage is derived from r.f. drive to base of Q2. Care must be exercised that measurement method does not load Oscillator Q1 in such a way as to stop oscillation. Suggest meter with decoupling resistor in probe such as HP 410C.

TABLE 4-28. VOLTAGE MEASUREMENTS, 400-HZ AND HIGH VOLTAGE SUPPLY A228

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
A1Q1	2N3569	0	+0.25*	+0.25*
A1Q2	2N3638A	+7.5	+7	+1
A1Q3	2N3638A	+7.5	+7	+1
A1Q4	2N3569	0	+0.25*	+0.25*

* Voltages indicated are result of measuring d.c. coupled square wave having twice amplitude indicated by averaging meter.

TABLE 4-29. VOLTAGE MEASUREMENTS, HEAT SINK A229

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N2492	+27	+10*	+13.5*
Q2	2N2492	+27	+10*	+13.5*
Q3	2N2015	0	+0.25*	+13.5*
Q4	2N2015	0	+0.25*	+13.5*
Q5	2N2492	-0.25	-0.4	-7
Q6	2N2492	-0.25	-0.4	-7
Q7	2N2869	-0.45	-0.25	-4

* Voltages are result of measuring square wave of twice amplitude indicated by averaging meter.

TABLE 4-30. VOLTAGE MEASUREMENTS, TRANSISTOR AND DIODE BRACKET A230

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N1483	+12	+12.5	+18
Q2	2N1483	+24	+24.5	+36
Q3	2N2869	-12	-12.5	-18
Q4	2N2869	-24	-24.5	-36
Q5	2N2869	-28.5*	-29*	-35*
Q6	2N1483	+28.5*	+29*	+35*

* Measured with respect to T302-14 (floating common)

TABLE 4-31. VOLTAGE MEASUREMENTS, +27 VOLT SUPPLY OVERLOAD PROTECTOR A234

Reference Symbol Number	Transistor Type	Nominal Emitter Voltage	Nominal Base Voltage	Nominal Collector Voltage
Q1	2N3053	-7	-7	0
Q2	2N1483	-7	-7	0
Q3	2N3055	-7	-7	0

CAUTION DO NOT MEASURE THESE VOLTAGES WITH ANY METER HAVING AN INPUT RESISTANCE LESS THAN 100 MEGOHMS BECAUSE OF THE PROBABILITY OF SWITCHING THE CIRCUIT ON.

TABLE 2-3. INITIAL CONTROL SETTINGS

Control	Setting
Data Evaluation Unit	
Power switch	Off
METER RESPONSE switch	ZERO
IF GAIN control	Mid-range
MULTIPLIER switch	X10° +0 DB
ANALYSIS MODE switch	PEAK
SIGNAL THRESHOLD control	Fully clockwise
SLIDEBACK THRESHOLD control	Fully counterclockwise
SWEEP MODE switch	MANUAL
AFC switch	OFF
AFC Δf control	Mid-range
PEAK HOLD switch	.01 SEC
PEAK HOLD control	CAL (fully clockwise)
VIDEO GAIN control	Mid-range
VIDEO STRETCH switch	30uS
BAND SWITCH	BAND 1
BAND WIDTH switch	5 MHZ
SWEEP RATE switch	SLOW
SWEEP RATE control	OFF (Fully counterclockwise)
LOWER LIMIT control	Fully counterclockwise
UPPER LIMIT control	Fully clockwise
Frequency Selection Unit	
Tuning controls	To obtain frequency indicator readings corresponding to the low-frequency limit of each tuner

2-16. MANUALLY TUNED OPERATION. To search for the presence of a signal by manual tuning of the equipment, prepare the EMA-910 for use as detailed in paragraph 2-15 and then continue as directed in the following steps.

Note

If the applied signal frequency is known, set the BAND SWITCH to the band in which the frequency lies. Disregard all band switching instructions in the following procedure and mentally change all band references to that of the tuner in which the signal lies.

a. With no signal being applied to the EMA-910, note the output meter pointer deflection; this corresponds to inherent internal noise.

b. Couple the signal under analysis (antenna output or output of device under test) to the RF INPUT connector.

c. Rotate the BAND 1 tuning control clockwise in search of the presence of a signal component. Note that, in the absence of a signal component, the output meter pointer will smoothly fluctuate with rotation of the tuning control. Interception of a signal component, however, will cause the output meter pointer to rise sharply upscale. Continue rotating the tuning control clockwise to obtain a maximum on-scale output meter indication. Should the output meter pointer deflect to an off-scale indication before reaching a maximum, rotate the MULTIPLIER switch one step clockwise. Alternately rotate the tuning control clockwise and resetting the MULTIPLIER switch as required until a maximum on-scale output meter indication is obtained.

d. Set the BAND WIDTH switch to 1 MHZ and carefully adjust the tuning control to once again obtain a maximum output meter indication.

e. Note the frequency to which the EMA-910 is tuned and refer to figure 2-4.

f. Momentarily depress the CALIBRATE pushbutton switch and, while the switch is held depressed, adjust the IF GAIN control to obtain the output meter DB ABOVE 1 MICROVOLT scale indication specified in figure 2-4 at the frequency to which the EMA-910 is tuned.

g. Release the CALIBRATE pushbutton switch after adjusting the IF GAIN control.

Note

The EMA-910 is now calibrated at the frequency indicated. Do not re-adjust the setting of the IF GAIN control when making measurements at this frequency. Should the EMA-910 be tuned to another frequency, the equipment must be recalibrated as directed in step f.

h. Note both the output meter indication (on the DB ABOVE 1 MICROVOLT scale) and the dB indication of the MULTIPLIER switch (e.g., +20 DB).

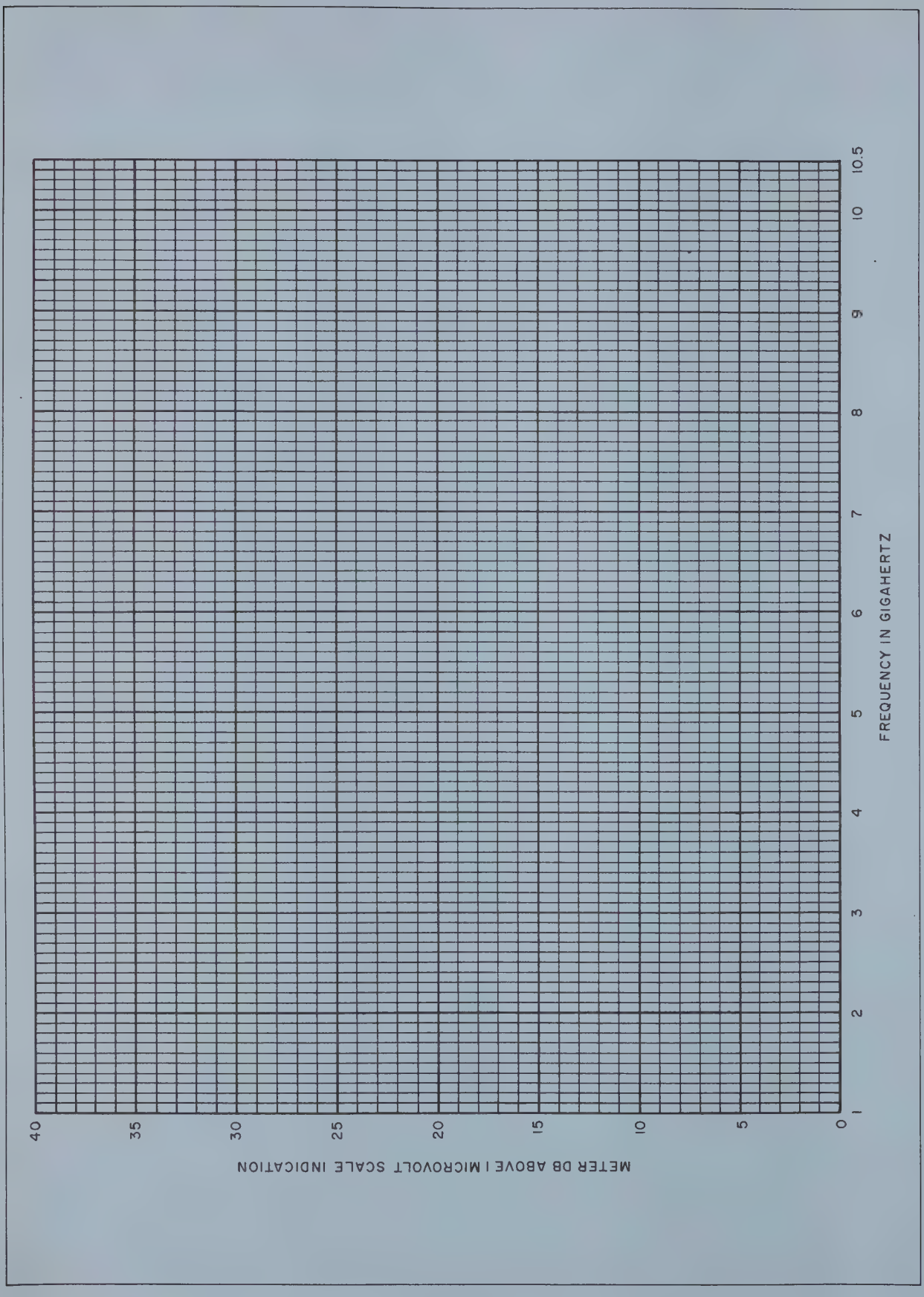


Figure 2-4. Gain Calibration Curve

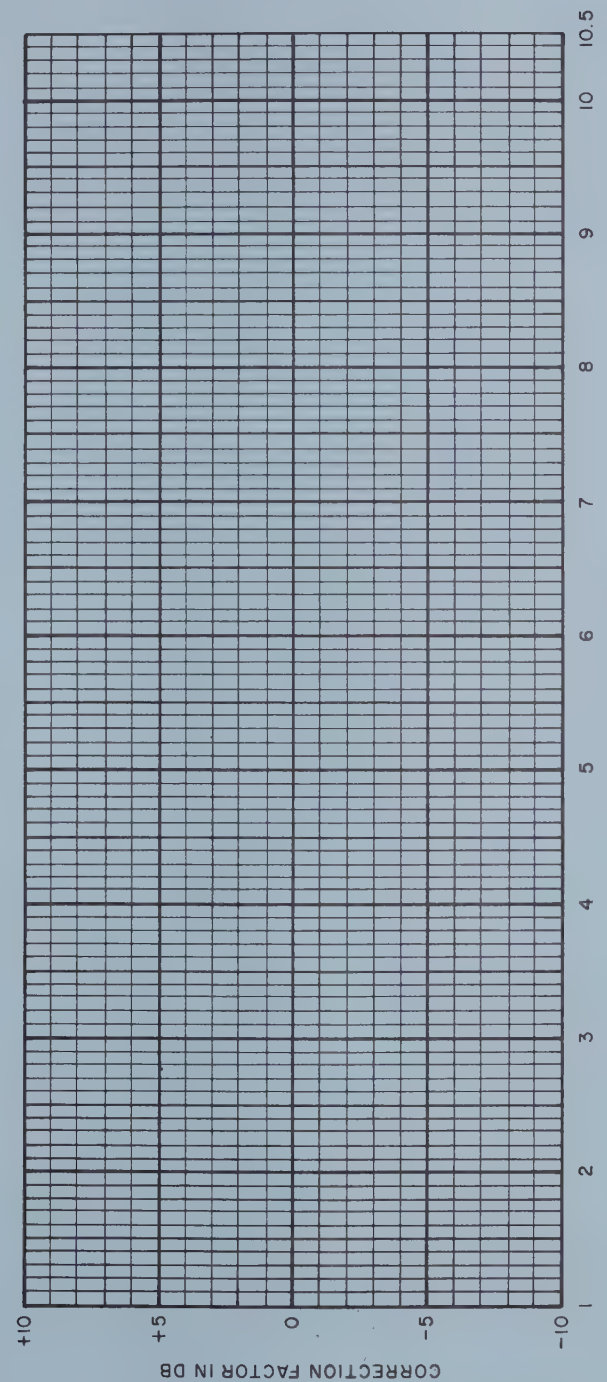


Figure 2-9. Normalization Curve

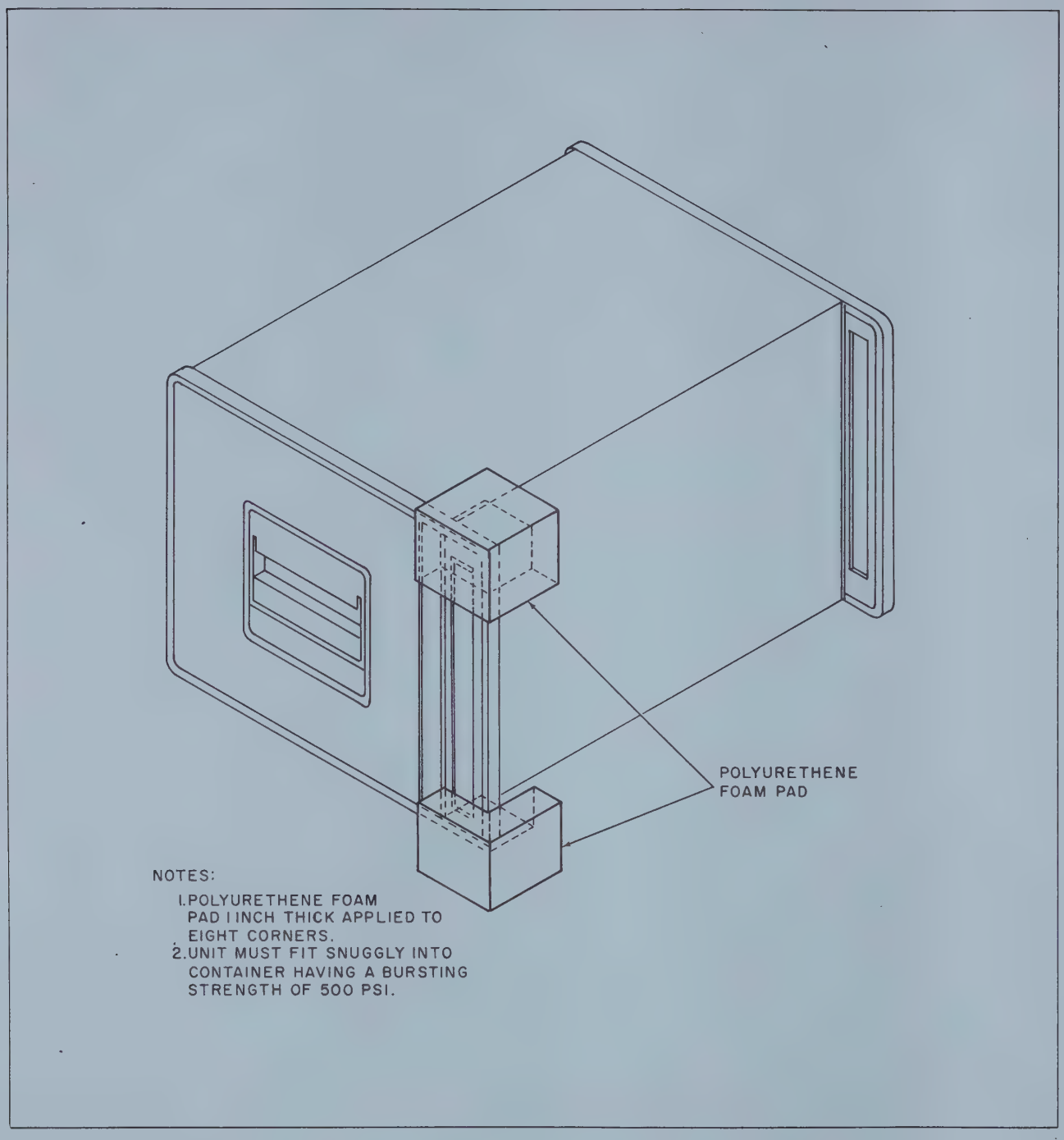
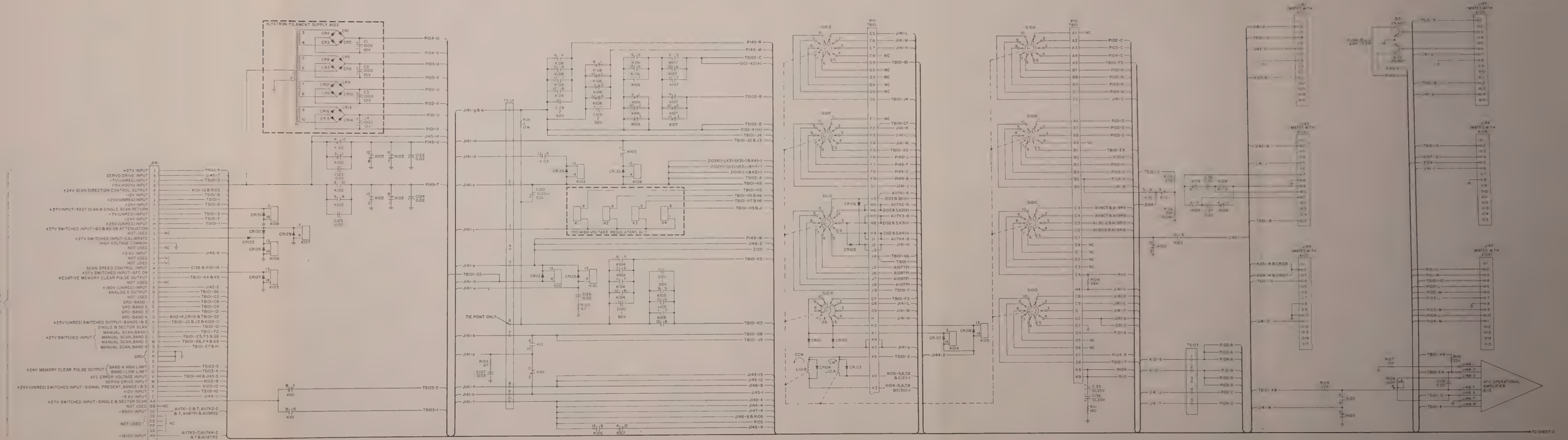

POLYURETHENE
FOAM PAD
NOTES:
1. POLYURETHENE FOAM PAD 1 INCH THICK APPLIED TO EIGHT CORNERS.
2. UNIT MUST FIT SNUGGLY INTO CONTAINER HAVING A BURSTING STRENGTH OF 500 PSI.

Figure 2-10. Packaging Diagram

SECTION V
SCHEMATIC DIAGRAMS


KLYSTRON FILAMENT SUPPLY A122
+27V INPUT
SERVO DRIVE INPUT
-7V (UNREG) INPUT
115V,400 Hz INPUT
+24V SCAN DIRECTION CONTROL OUTPUT
+12V INPUT
+25V (UNREG) INPUT
+24V INPUT
+27V INPUT-FAST SCAN & SINGLE SCAN RETURN
-7V (UNREG) INPUT
-24V INPUT
+25V (UNREG) INPUT
+27V SWITCHED INPUT -60 & 80 DB ATTENUATION
NOT USED
+27V SWITCHED INPUT-CALIBRATE
HIGH VOLTAGE COMMON
NOT USED
+5 6V INPUT
NOT USED
NOT USED
SCAN SPEED CONTROL INPUT
+27V SWITCHED INPUT-AFC ON
NEGATIVE MEMORY CLEAR PULSE OUTPUT
NOT USED
+I80V (UNREG) INPUT
ANALOG X OUTPUT
NOT USED
GRO-BAND 1
GRO-BAND 2
GRO-BAND 3
GRO-BAND 4
+25V (UNREG) SWITCHED OUTPUT-BANDS I & J
SINGLE & SECTOR SCAN
MANUAL SCAN, BAND 1
+27V SWITCHED INPUT
MANUAL SCAN, BAND 2
MANUAL SCAN, BAND 3
MANUAL SCAN, BAND 4
GRD
+24V MEMORY CLEAR PULSE OUTPUT
BAND 4 HIGH LIMIT
BAND 1 LOW LIMIT
AFC ERROR VOLTAGE INPUT
SERVO DRIVE INPUT
+25V (UNREG) SWITCHED INPUT-SIGNAL PRESENT, BANDS I & J
+12V INPUT
+5 6V INPUT
+27V SWITCHED INPUT-SINGLE & SECTOR SCAN
NOT USED
-650V INPUT
NOT USED
-I6I0V INPUT
TO POWER OUT CONNECTOR J217 OF DATA EVALUATION UNIT (SEE FIG 5-9)
J104
J146-6
J142-2
J143-15
J145-12
J148-8
J145-1
J142-4
J144-4
J147-4
J146-6 & R108
R105
J146-4
J141-L
J141-M
J141-N
J141-C
J141-K
J141-A
J141-J
J141-B
J141-P
J141-F
J141-E
J141-D
J141-H
J141-X
J141-E
J141-J
J141-G
J141-U
J141-V
J141-W
J141-T
J141-S
J141-R
J141-Y
J141-P
J141-M
J141-N
J141-L
J141-K
J141-J
J141-H
J141-G
J141-F
J141-E
J141-D
J141-C
J141-B
J141-A
J142-A
J142-B
J142-C
J142-D
J142-E
J142-F
J142-H
J142-J
J142-K
J142-L
J142-M
J142-N
J142-P
J142-R
J142-S
J142-T
J142-U
J142-V
J142-W
J142-X
J142-Y
J143-A
J143-B
J143-C
J143-D
J143-E
J143-F
J143-H
J143-J
J143-K
J143-L
J143-M
J143-N
J143-P
J143-R
J143-S
J143-T
J143-U
J143-V
J143-W
J143-X
J143-Y
J144-A
J144-B
J144-C
J144-D
J144-E
J144-F
J144-H
J144-J
J144-K
J144-L
J144-M
J144-N
J144-P
J144-R
J144-S
J144-T
J144-U
J144-V
J144-W
J144-X
J144-Y
J145-A
J145-B
J145-C
J145-D
J145-E
J145-F
J145-H
J145-J
J145-K
J145-L
J145-M
J145-N
J145-P
J145-R
J145-S
J145-T
J145-U
J145-V
J145-W
J145-X
J145-Y
J146-A
J146-B
J146-C
J146-D
J146-E
J146-F
J146-H
J146-J
J146-K
J146-L
J146-M
J146-N
J146-P
J146-R
J146-S
J146-T
J146-U
J146-V
J146-W
J146-X
J146-Y
J147-A
J147-B
J147-C
J147-D
J147-E
J147-F
J147-H
J147-J
J147-K
J147-L
J147-M
J147-N
J147-P
J147-R
J147-S
J147-T
J147-U
J147-V
J147-W
J147-X
J147-Y
P149-U
P149-V
P149-T
P149-R
P149-M
P149-W
P149-J
P149-F
P149-C
P149-B
P149-P
P149-N
P149-L
P149-K
P149-E
P149-D
P149-S
P149-H
P149-G
P104-U
P104-V
P103-U
P103-V
P102-U
P102-V
P101-U
P101-V
P145-H
P102-C
P103-C
P104-C
P101-C
P102-N
P103-N
P104-N
P101-N
P102-D
P103-D
P104-D
P101-D
P102-E
P103-E
P104-E
P101-E
P102-F
P103-F
P104-F
P101-F
P102-H
P103-H
P104-H
P101-H
P102-J
P103-J
P104-J
P101-J
P102-K
P103-K
P104-K
P101-K
P102-L
P103-L
P104-L
P101-L
P102-M
P103-M
P104-M
P101-M
P102-P
P103-P
P104-P
P101-P
P102-R
P103-R
P104-R
P101-R
P102-S
P103-S
P104-S
P101-S
P102-T
P103-T
P104-T
P101-T
P102-U
P103-U
P104-U
P101-U
P102-V
P103-V
P104-V
P101-V
TS102-C
TS102-B
TS102-D
TS102-A
TS101-A
TS101-B
TS101-C
TS101-D
TS101-E
TS101-F
TS101-H
TS101-J
TS101-K
TS101-L
TS101-M
TS101-N
TS101-P
TS101-R
TS101-S
TS101-T
TS101-U
TS101-V
TS103-2
TS103-1
TS103-5
TS103-4
TS103-3
TS103-10
TS103-9
TS103-12
TS103-11
TS103-8
TS103-7
TS103-6
TS102-K
TS102-J
TS102-H
TS102-G
TS102-F
TS102-E
TS102-S
TS102-R
TS102-P
TS102-N
TS102-M
TS102-L
TS102-U
TS102-V
TS102-W
TS102-X
TS102-Y
TS102-Z
TS102-1
TS102-2
TS102-3
TS102-4
TS102-5
TS102-6
TS102-7
TS102-8
TS102-9
TS102-10
TS102-11
TS102-12
TS102-13
TS102-14
TS102-15
TS102-16
TS102-17
TS102-18
TS102-19
TS102-20
TS102-21
TS102-22
TS102-23
TS102-24
TS102-25
TS102-26
TS102-27
TS102-28
TS102-29
TS102-30
TS102-31
TS102-32
TS102-33
TS102-34
TS102-35
TS102-36
TS102-37
TS102-38
TS102-39
TS102-40

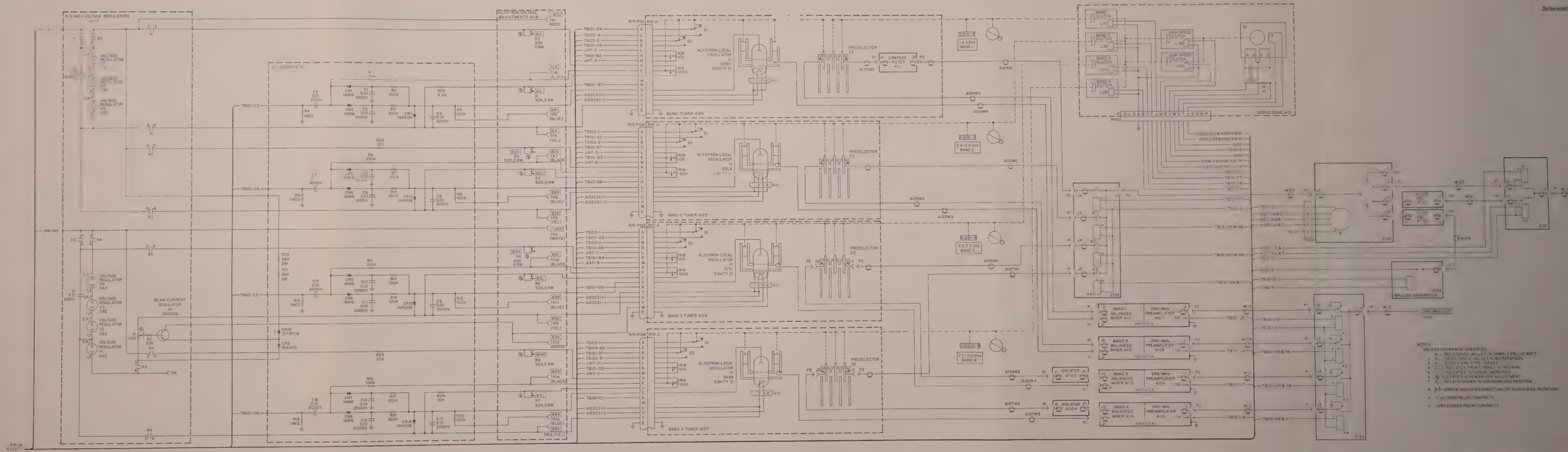
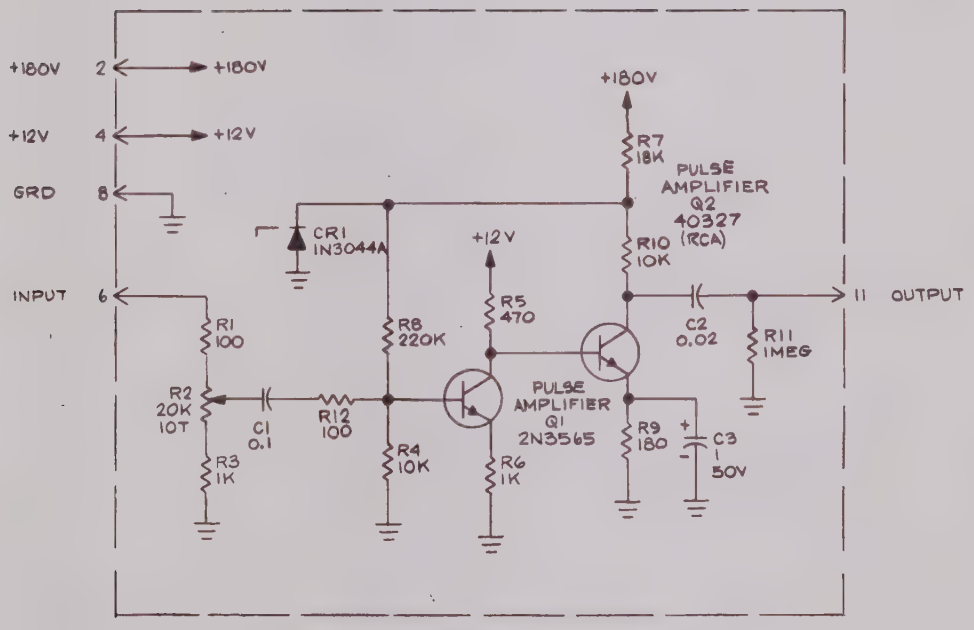
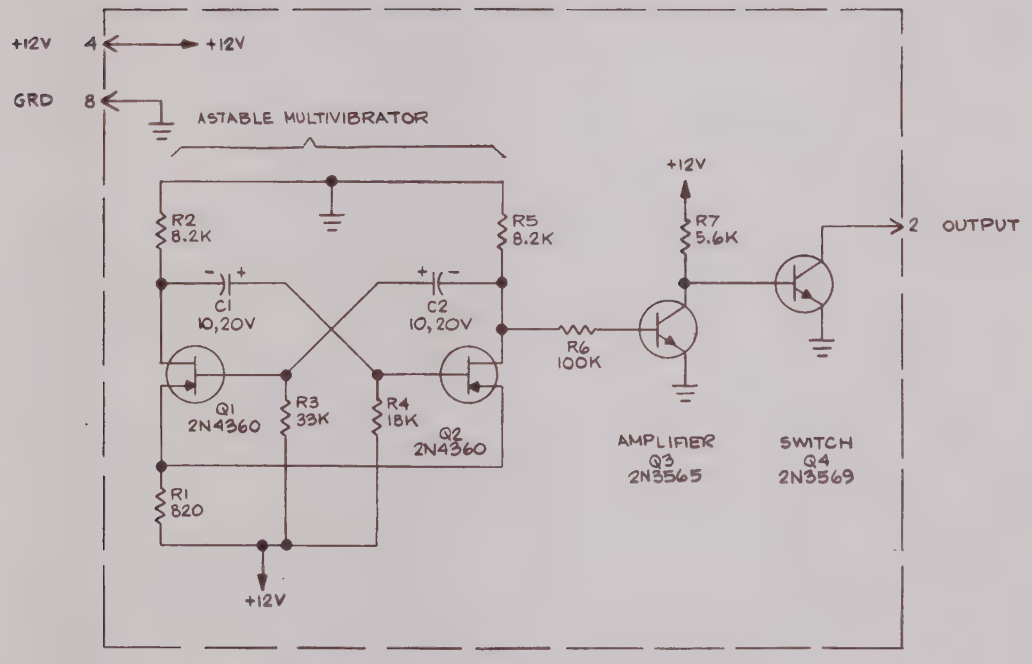


Figure 5-1. Model EMA-910-10 Frequency Selection Unit, Schematic and Interassembly Wiring Diagram (Sheet 2 of 2)



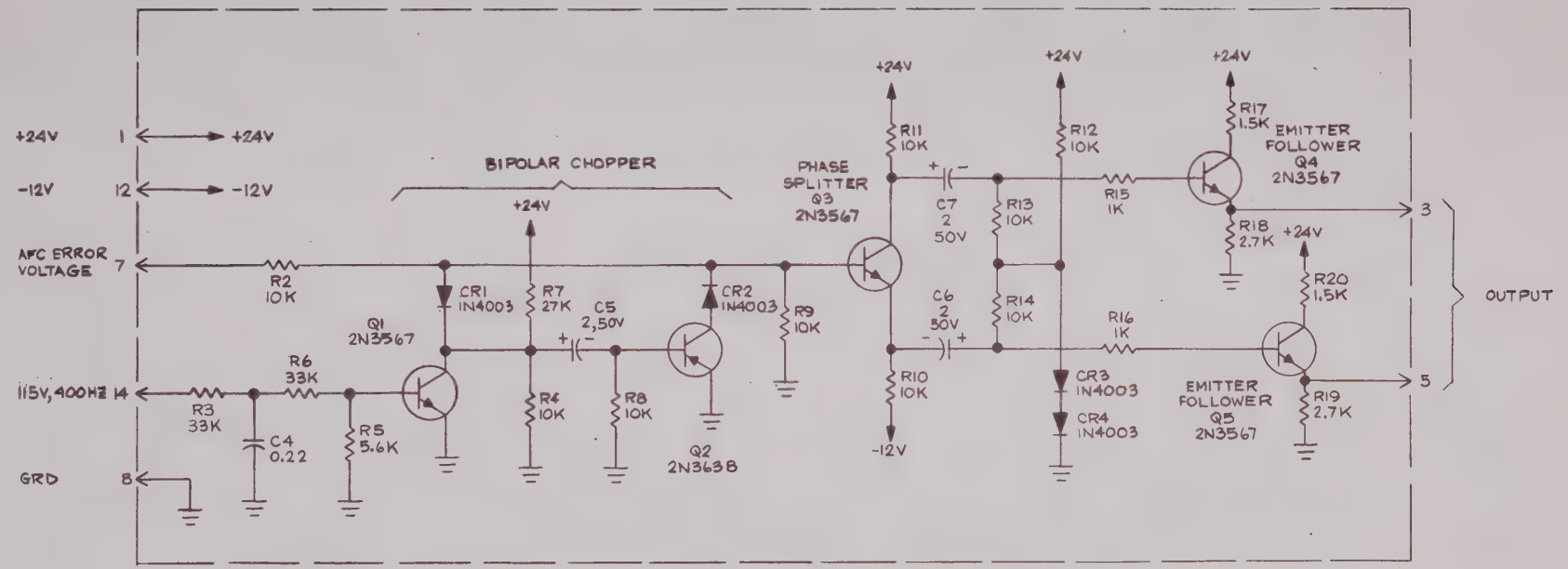
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 5-2. Afc Pulse Amplifier A101, Schematic Diagram



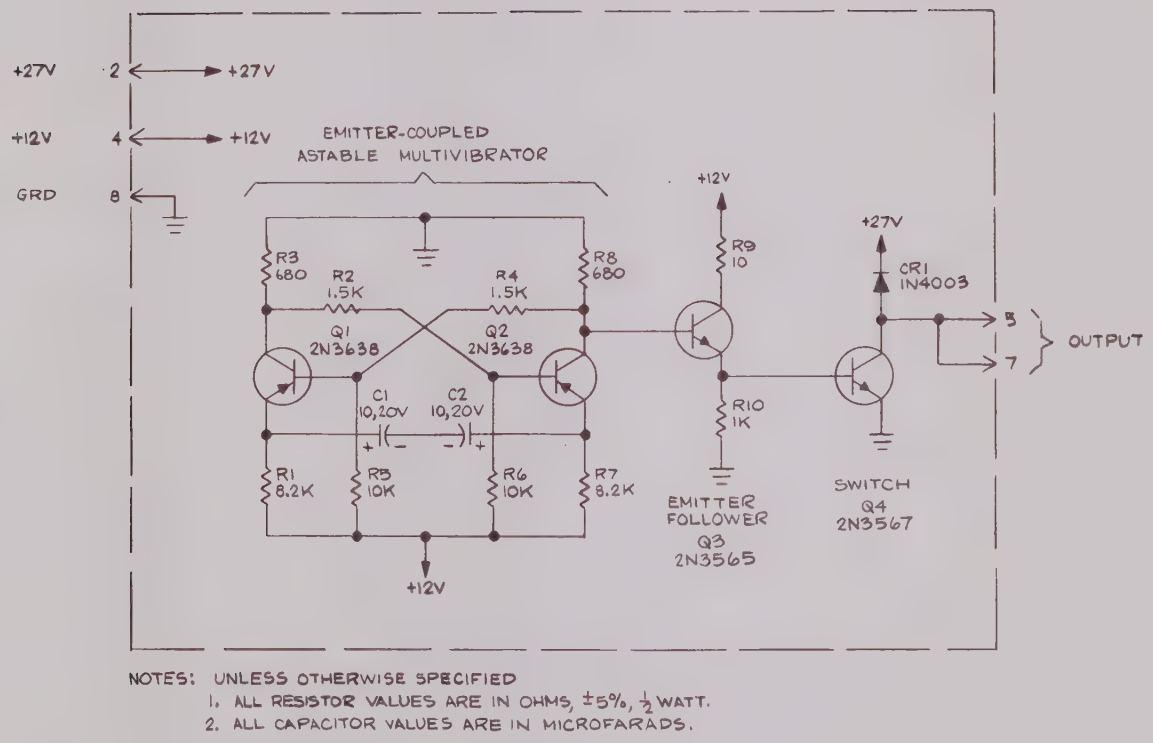
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 5-3. Clock Oscillator A102, Schematic Diagram



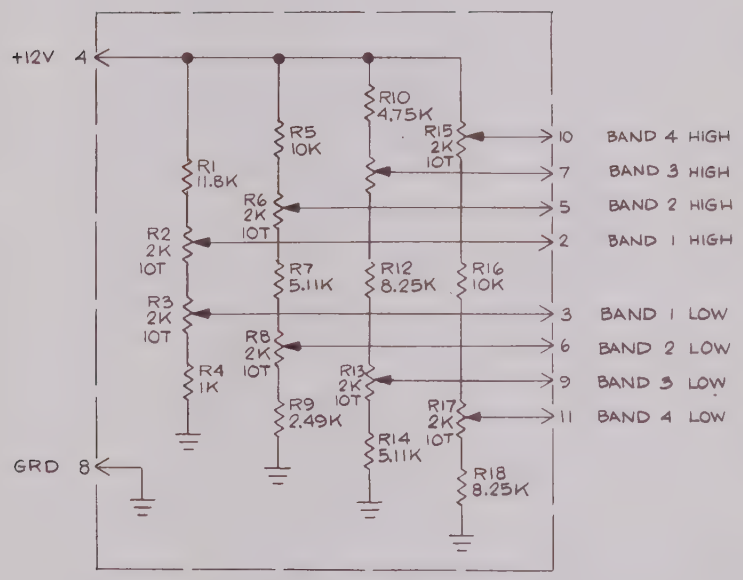
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 5-4. Servo Bipolar Chopper/Preamplifier A103, Schematic Diagram



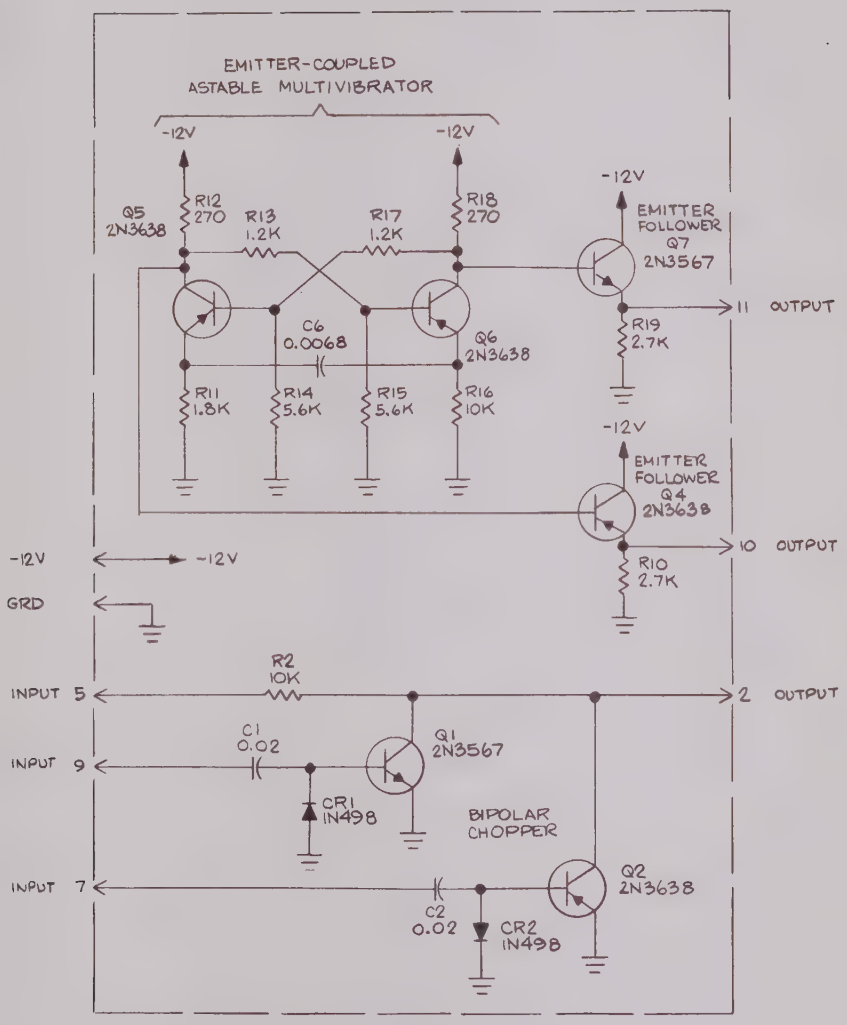
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 5-5. Impulse Generator Driver A104, Schematic Diagram



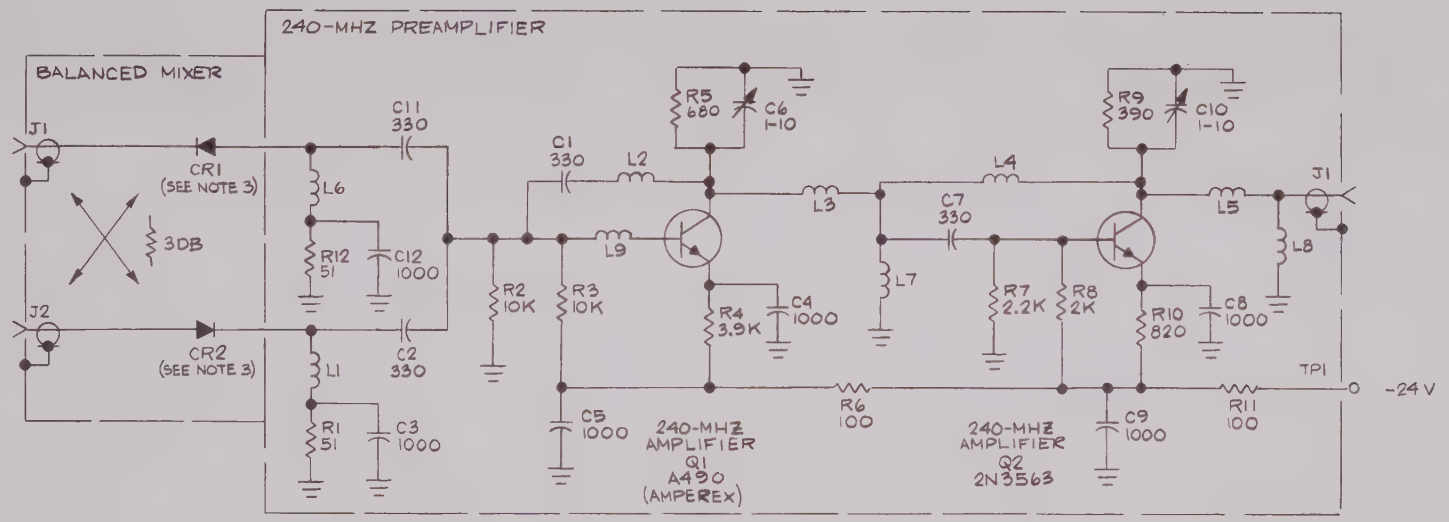
NOTES: UNLESS OTHERWISE SPECIFIED
ALL RESISTOR VALUES ARE IN OHMS, ±1%, $\frac{1}{4}$ WATT.

Figure 5-6. Analog X Voltage Tracking Adjustments A105, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS

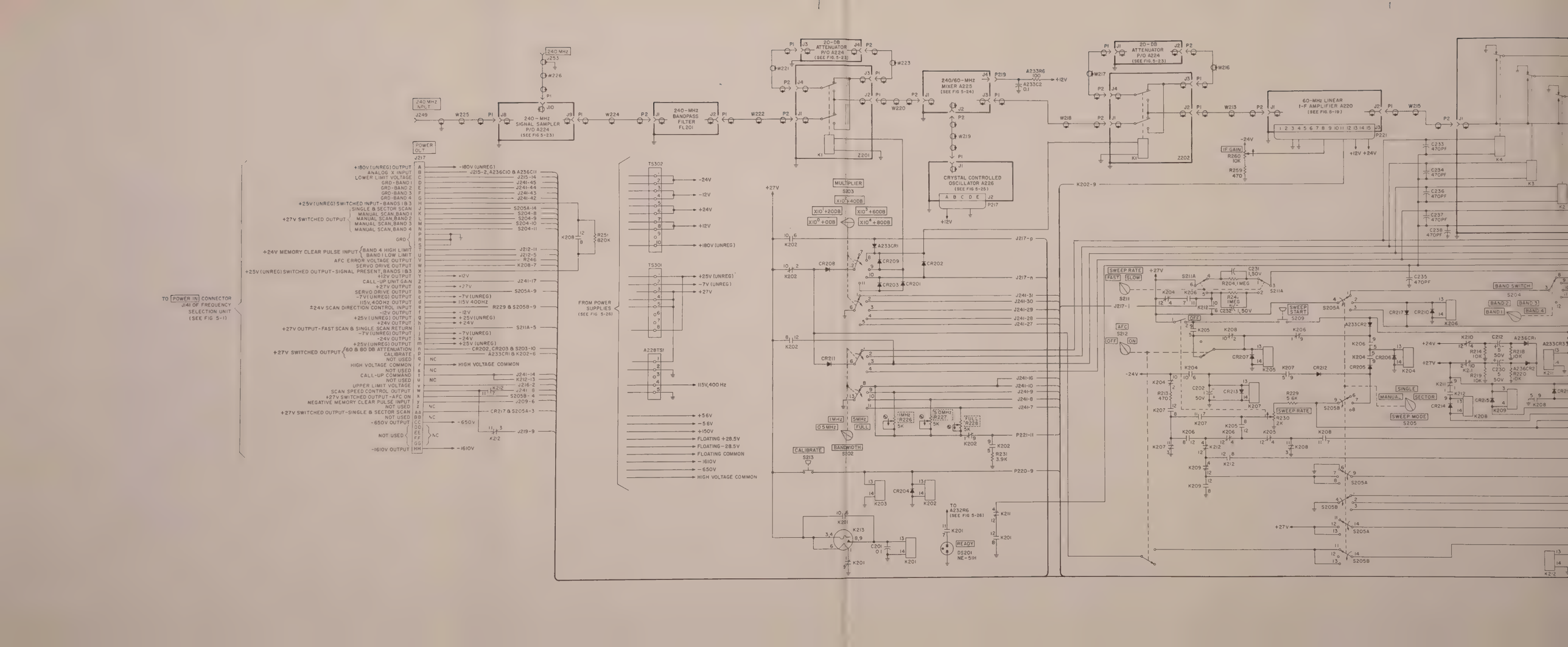
Figure 5-7. Afc Bipolar Chopper A106, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ¼ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. CR1 AND CR2 ARE 1N416G FOR A111 AND A112; 1N415G FOR A113; DS190-MR (SYLVANIA) FOR A114

Figure 5-8. 240-MHz Preamplifiers A107, A108, A109 and A110 and Balanced Mixers A111, A112, A113 and A114, Schematic Diagram


240 MHz
J253
W226
P1
J10
240 MHz SIGNAL SAMPLER P/O A224 (SEE FIG 5-23)
J9
240 MHz NPLT
J249
W225
P1
J8
P1
W224
P2
J1
240-MHz BANDPASS FILTER FL201
J2
P1
W222
P2
J1
P1
J3
20-DB ATTENUATOR P/O A224 (SEE FIG 5-23)
J4
P2
W221
P2
J4
P1
J3
P1
J2
P1
W220
P2
J1
240/60-MHz MIXER A225 (SEE FIG 5-24)
J4
P219
A233R6 100
A233C2 0.1
+12V
J3
P1
W218
P2
J1
P1
J1
20-DB ATTENUATOR P/O A224 (SEE FIG 5-23)
J2
P2
W216
W217
P2
J4
P1
J3
P1
J2
P1
W213
P2
J1
60-MHz LINEAR I-F AMPLIFIER A220 (SEE FIG 6-19)
J2
P1
W215
P2
J1
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
J3
P221
K1
Z202
K1
Z201
P1
W219
P1
J1
CRYSTAL CONTROLLED OSCILLATOR A226 (SEE FIG 5-25)
A B C D E
J2
P217
+12V
-24V
IF GAIN
R260 10K
R259 470
+12V +24V
C233 470PF
C234 470PF
C236 470PF
C237 470PF
C238 470PF
K4
K3
K2
POWER OUT
J217
TO POWER IN CONNECTOR J41 OF FREQUENCY SELECTION UNIT (SEE FIG 5-1)
+180V (UNREG) OUTPUT
ANALOG X INPUT
LOWER LIMIT VOLTAGE
GRD - BAND 1
GRD - BAND 2
GRD - BAND 3
GRD - BAND 4
+25V (UNREG) SWITCHED INPUT - BANDS 1 & 3
+27V SWITCHED OUTPUT
SINGLE & SECTOR SCAN
MANUAL SCAN, BAND 1
MANUAL SCAN, BAND 2
MANUAL SCAN, BAND 3
MANUAL SCAN, BAND 4
GRD
+24V MEMORY CLEAR PULSE INPUT
BAND 4 HIGH LIMIT
BAND 1 LOW LIMIT
AFC ERROR VOLTAGE OUTPUT
SERVO DRIVE OUTPUT
+25V (UNREG) SWITCHED OUTPUT - SIGNAL PRESENT, BANDS 1 & 3
+12V OUTPUT
CALL-UP UNIT GAIN
+27V OUTPUT
SERVO DRIVE OUTPUT
-7V (UNREG) OUTPUT
115V, 400Hz OUTPUT
±24V SCAN DIRECTION CONTROL INPUT
-12V OUTPUT
+25V (UNREG) OUTPUT
+24V OUTPUT
+27V OUTPUT - FAST SCAN & SINGLE SCAN RETURN
-7V (UNREG) OUTPUT
-24V OUTPUT
+25V (UNREG) OUTPUT
+27V SWITCHED OUTPUT
60 & 80 DB ATTENUATION CALIBRATE
NOT USED
HIGH VOLTAGE COMMON
NOT USED
CALL-UP COMMAND
NOT USED
UPPER LIMIT VOLTAGE
SCAN SPEED CONTROL OUTPUT
+27V SWITCHED OUTPUT - AFC ON
NEGATIVE MEMORY CLEAR PULSE INPUT
NOT USED
+27V SWITCHED OUTPUT - SINGLE & SECTOR SCAN
NOT USED
-650V OUTPUT
NOT USED
-1610V OUTPUT
-180V (UNREG)
J215-2, A236C10 & A236C11
J215-14
J241-45
J241-44
J241-43
J241-42
S205A-14
S204-8
S204-9
S204-10
S204-11
J212-11
J212-5
R246
K208-7
+12V
+27V
J241-17
S205A-9
-7V (UNREG)
115V, 400Hz
R229 & S205B-9
-12V
+25V (UNREG)
+24V
S211A-5
-7V (UNREG)
-24V
+25V (UNREG)
CR202, CR203 & S203-10
A233CR1 & K202-6
NC
HIGH VOLTAGE COMMON
NC
J241-14
NC
K212-13
J216-2
J241-8
S205B-4
J209-6
NC
CR217 & S205A-3
NC
-650V
J219-9
NC
-1610V
K212
K208
R251 820K
FROM POWER SUPPLIES (SEE FIG 5-26)
TS302
-24V
-12V
+24V
+12V
+180V (UNREG)
TS301
+25V (UNREG)
-7V (UNREG)
+27V
A228TS1
115V, 400Hz
+5.6V
-5.6V
+15V
FLOATING +28.5V
FLOATING -28.5V
FLOATING COMMON
-1610V
-650V
HIGH VOLTAGE COMMON
+27V
MULTIPLIER S203
X10^3 400B
X10^2 200B
X10^3 600B
X10^0 0B
X10^4 800B
J217-p
J241-n
J241-31
J241-30
J241-29
J241-28
J241-27
A233CR1
CR209
CR202
CR208
CR203
CR201
K202
CR211
J241-16
J241-10
J241-9
J241-8
J241-7
1MHz
5MHz
10MHz
FULL
R226 5K
R227 5K
R228 5K
P221-11
P220-9
CALIBRATE
S213
BANDWIDTH S102
R231 3.9K
CR204
K203
K202
K201
K213
C201 .01
TO A232R6 (SEE FIG 5-26)
READY
DS201 NE-51H
K211
K201
SWEEP RATE
FAST
SLOW
S211
S211A
R204 1MEG
C231 1.5pF
C232 1.5pF
AFC
OFF
ON
S212
SWEEP START
S209
S205A
A233CR2
CR217
CR210
K206
BAND SWITCH
S204
BAND 2
BAND 3
BAND 1
BAND 4
C235 470PF
CR207
CR206
CR205
CR212
K205
K207
K208
K210
C212
A236CR1
A233CR3
R214 10K
R218 10K
R219 10K
C230 50V
A236CR2
R220 10K
K211
K212
CR213
R213 470
R229 5K
R230 2K
SWEEP RATE
S205B
SINGLE
MANUAL
SECTOR
SWEEP MODE
S205
CR214
CR215
CR216
K209
S205A
S205B
K212

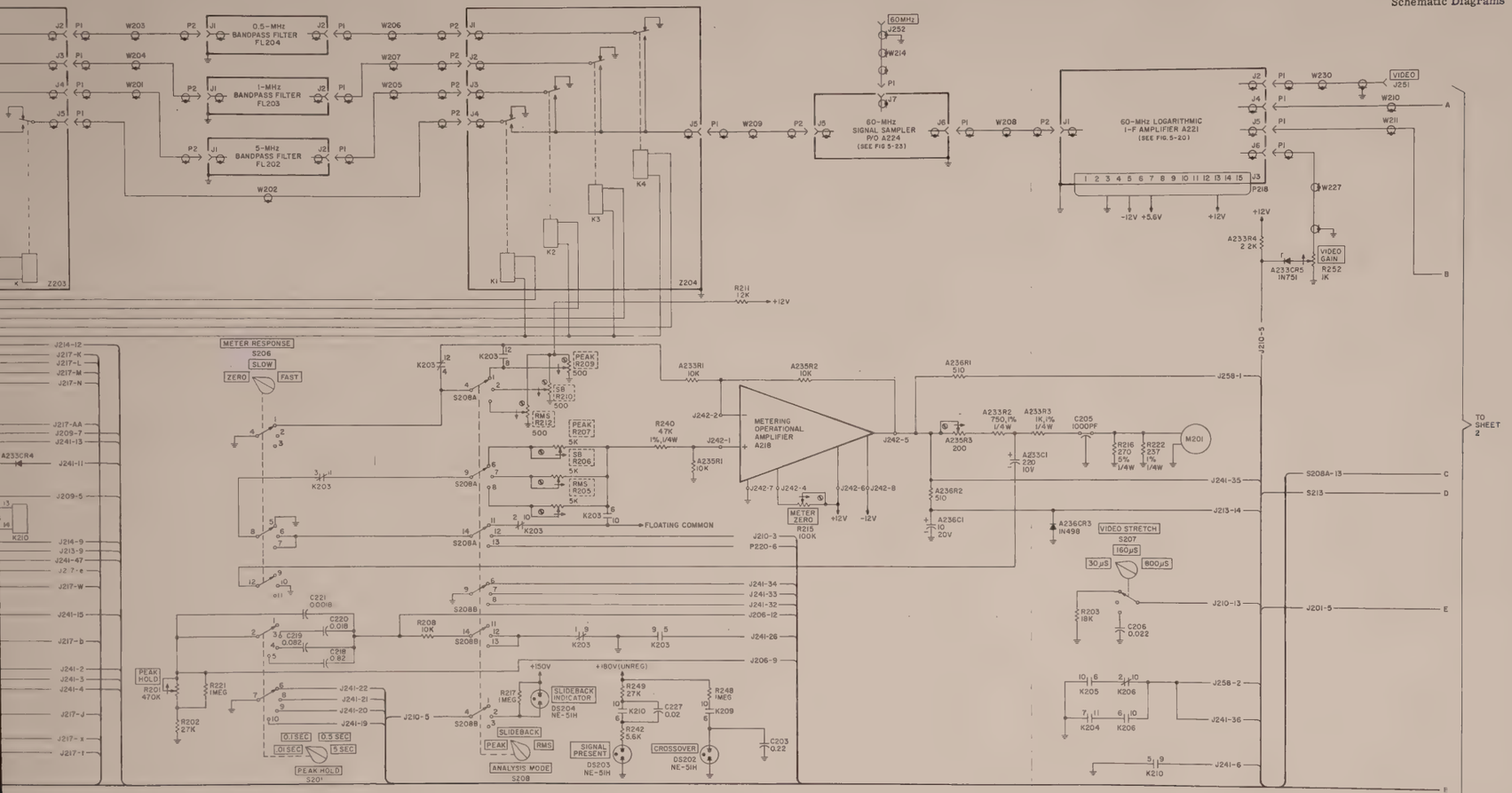
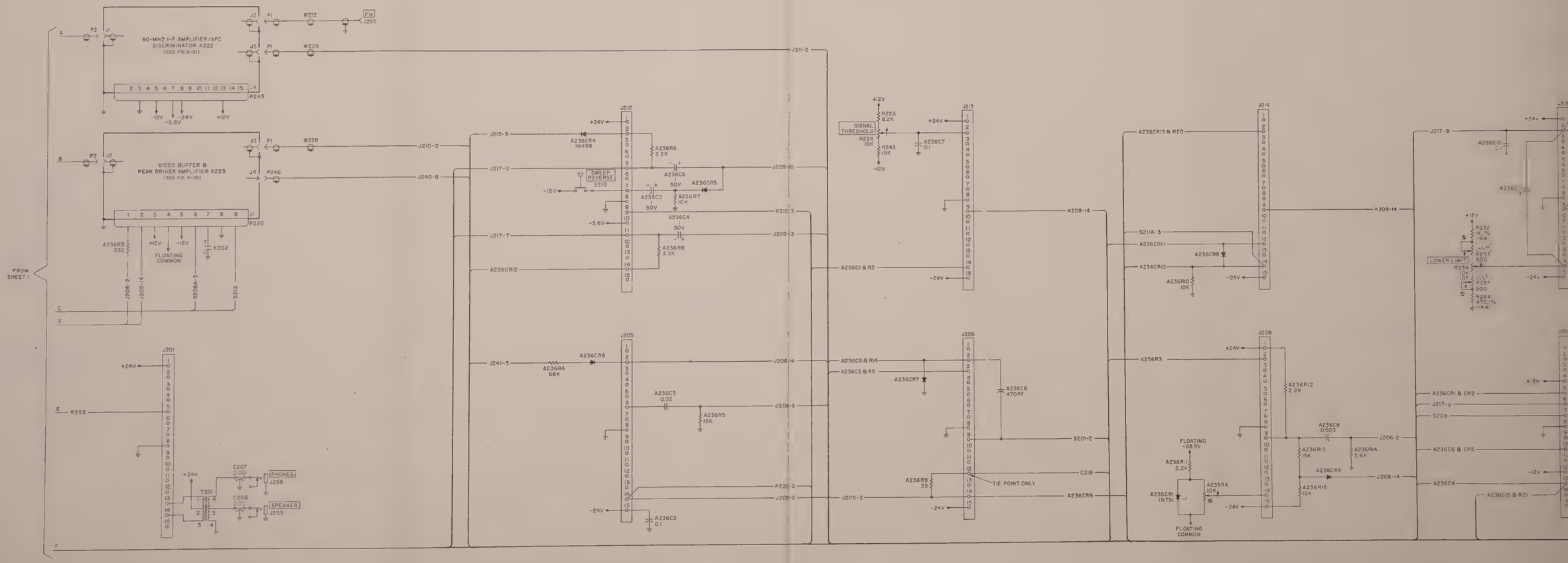


Figure 5-9. Model EMA-910-11 Data Evaluation Unit, Schematic and Interassembly Wiring Diagram (Sheet 1 of 2)


60-MHZ I-F AMPLIFIER/AFC DISCRIMINATOR A222
(SEE FIG. 5-21)
VIDEO BUFFER & PEAK DRIVER AMPLIFIER A223
(SEE FIG 5-22)
FROM SHEET 1
FM J250
W212
W229
W228
P245
P220
P246
J211-2
J210-2
J240-8
J215-9
J217-U
J217-T
A236CR12
J241-5
J208-2
J205-14
S208A-3
S213
A236R3 330
FLOATING COMMON
K202
J212
J205
J213
J214
J206
J208
J201
A236CR4 IN498
A236R6 3.3K
A236C6
A236CR5
A236C5
A236R7 10K
A236C4
A236R8 3.3K
SWEEP REVERSE S210
J209-10
J212-3
J209-13
A236CR6
A236R4 68K
A236C3 0.02
A236R5 15K
J206-14
J206-3
P220-2
J205-2
A236C2 0.1
SIGNAL THRESHOLD
R223 8.2K
R224 10K
R243 15K
A236C7 0.1
K208-14
A236C1 & R2
A236C9 & R14
A236C3 & R5
A236CR7
A236C8 470PF
S201-2
C218
A236R9 33
TIE POINT ONLY
A236CR9
A236CR13 & R20
S211A-3
A236CR11
A236CR10
A236R10 10K
A236R3
A236R12 2.2K
A236C9 0.003
A236R13 15K
A236R14 5.6K
J206-2
A236CR9
J206-14
A236R15 10K
FLOATING -28.5V
A236R11 2.2K
A235CR1 IN751
A235R4 10K
FLOATING COMMON
J217-8
A236C10 0.1
A236C5
K209-14
R232 1K, 1% 1/4W
LLH
LOWER LIMIT
R233 500
R234 10K
R237 500
R244 470, 1% 1/4W
A236CR1 & CR2
J217-y
S209
A236C6 & CR5
A236C4
A236C15 & R21
R253
C207 0.001
C208 0.01
T201
PHONES J256
SPEAKER J255
+24V
+12V
-12V
-24V
-5.6V

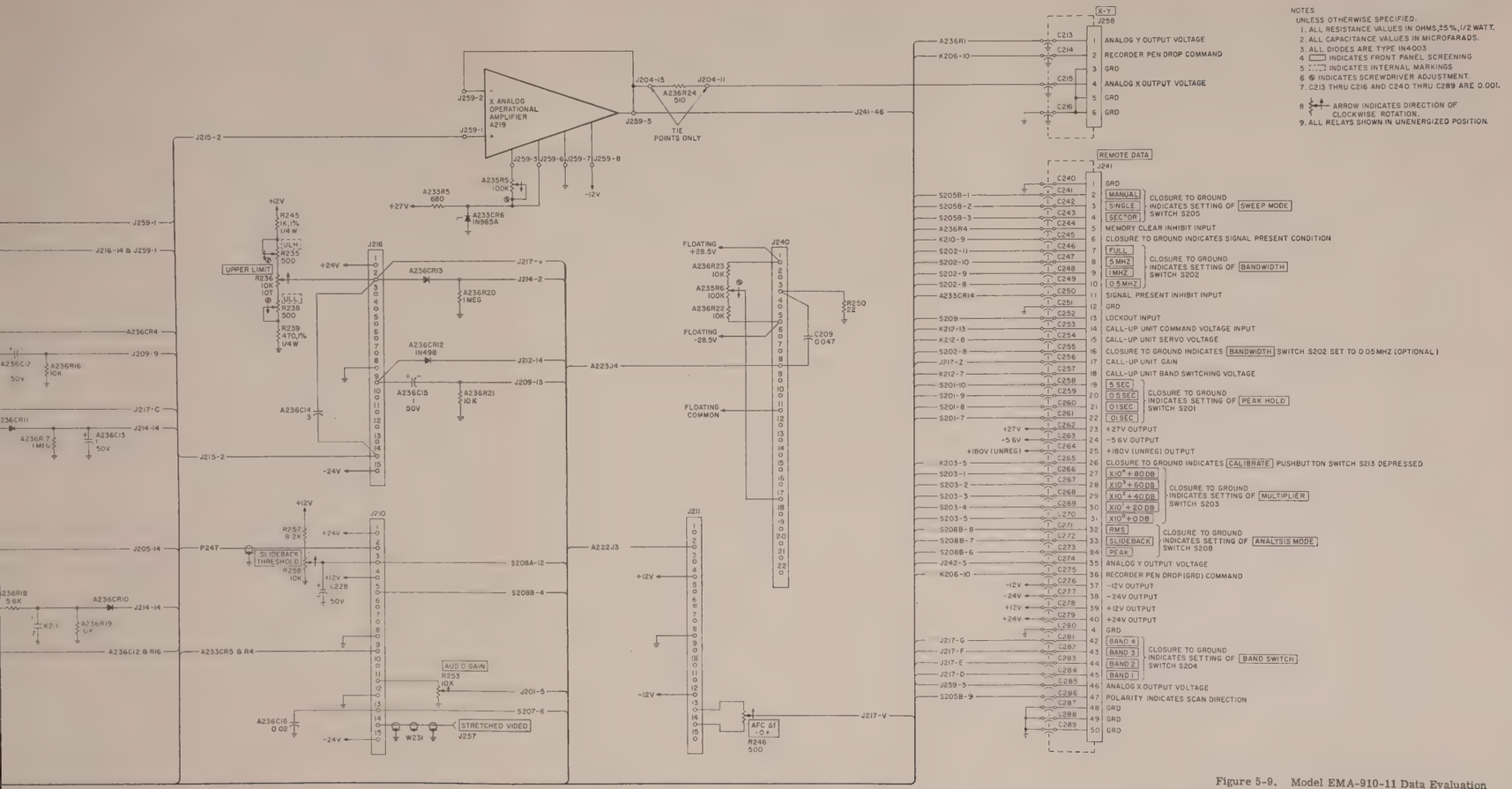
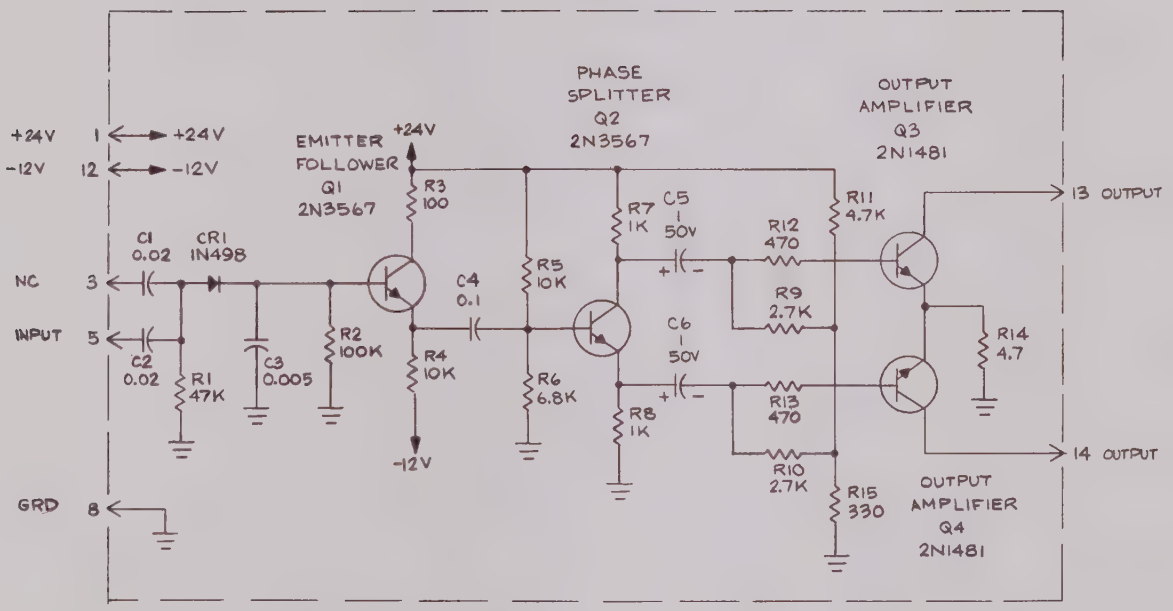
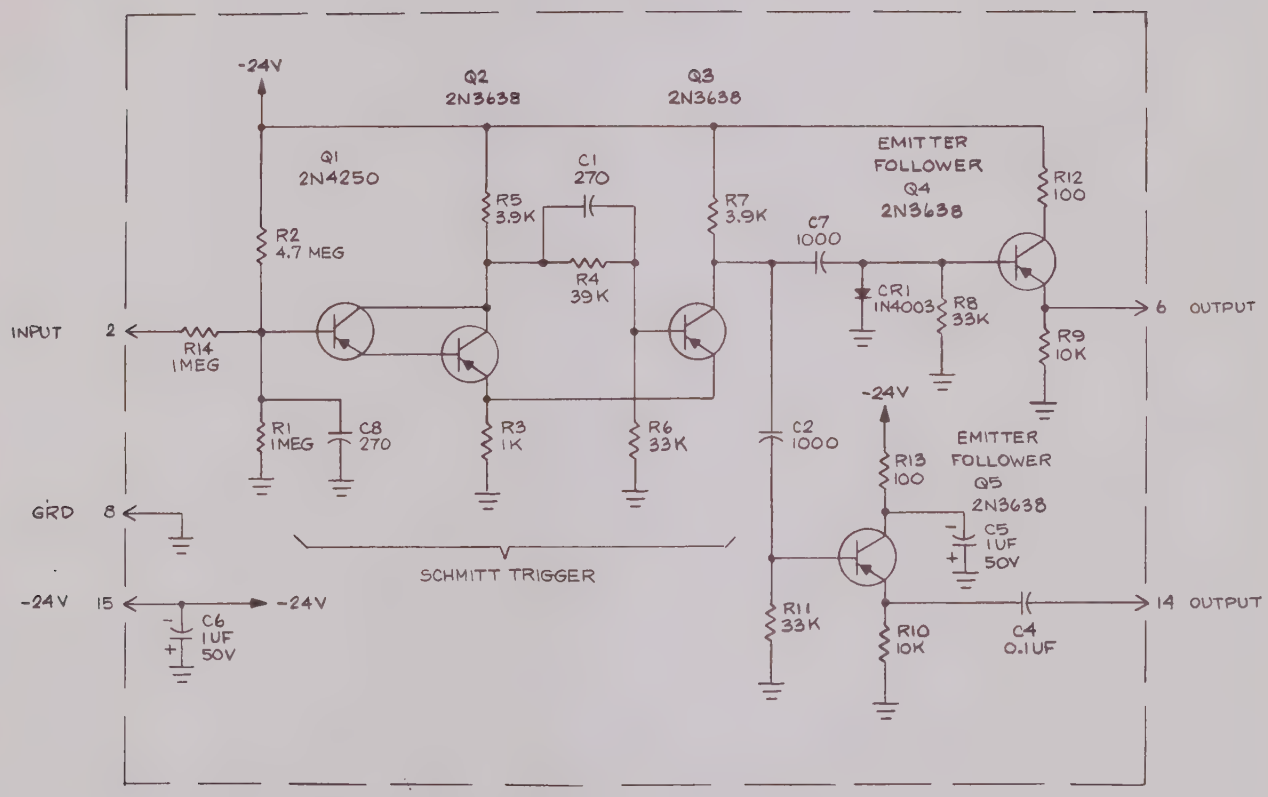


Figure 5-9. Model EMA-910-11 Data Evaluation Unit, Schematic and Interassembly Wiring Diagram (Sheet 2 of 2)



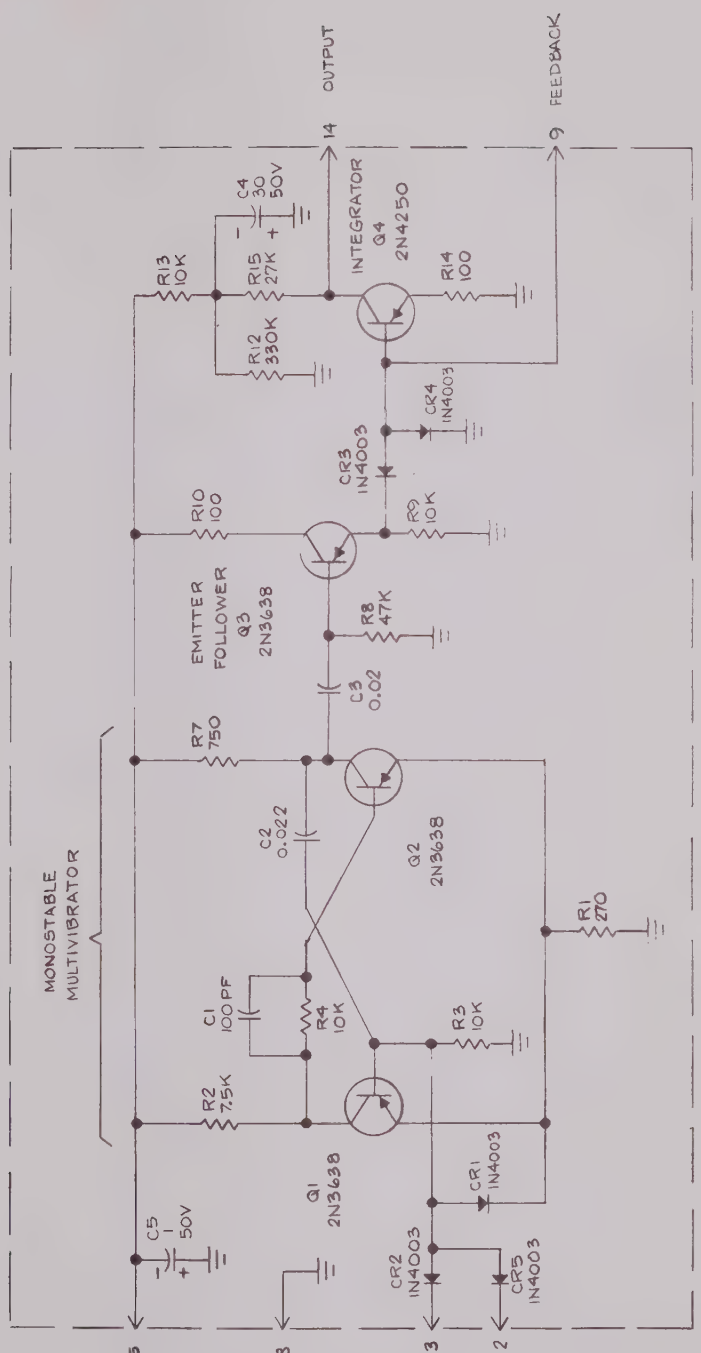
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 5-10. Audio Amplifier A201, Schematic Diagram



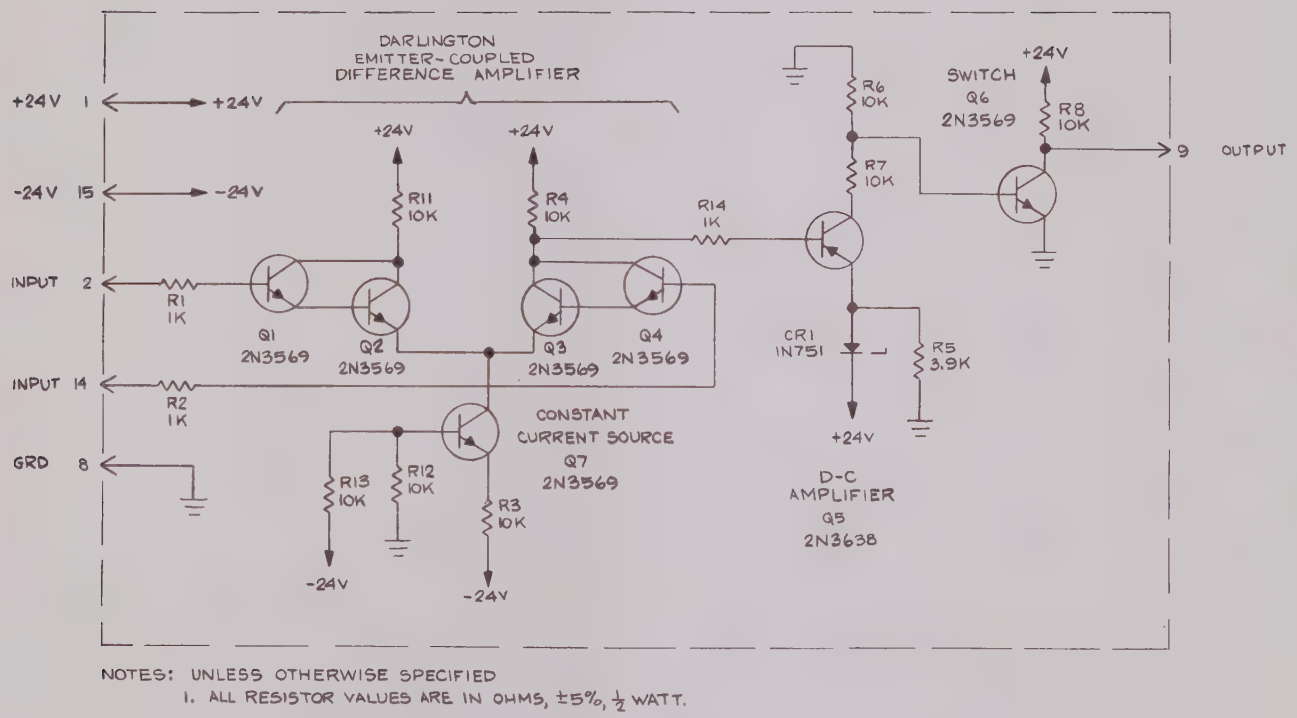
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.

Figure 5-11. Schmitt Trigger A205, Schematic Diagram



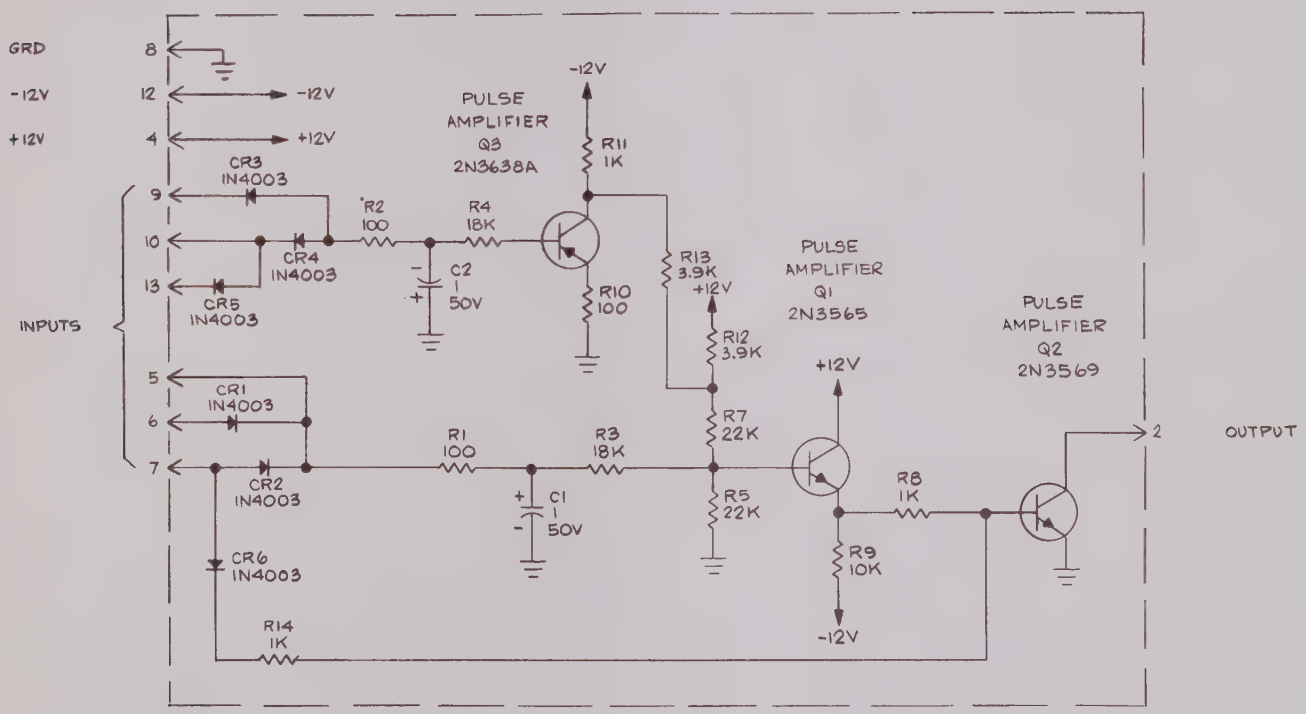
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 5-12. Multivibrator/Integrator A206, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.

Figure 5-13. Voltage Comparators A208, A213, A214, A215 and A216, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, $\frac{1}{2}$ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

Figure 5-14. Memory Clear Pulse Amplifier A209, Schematic Diagram

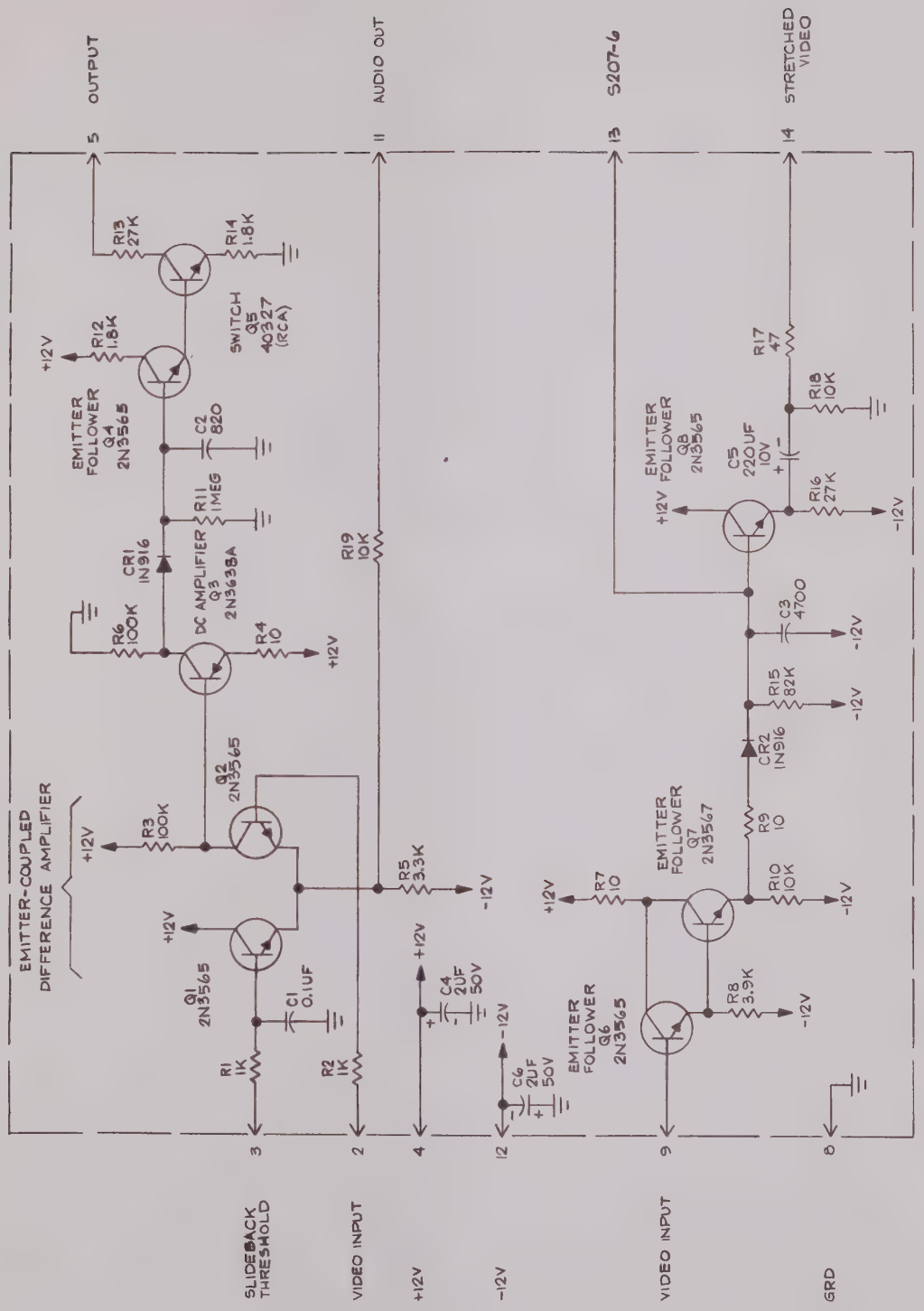
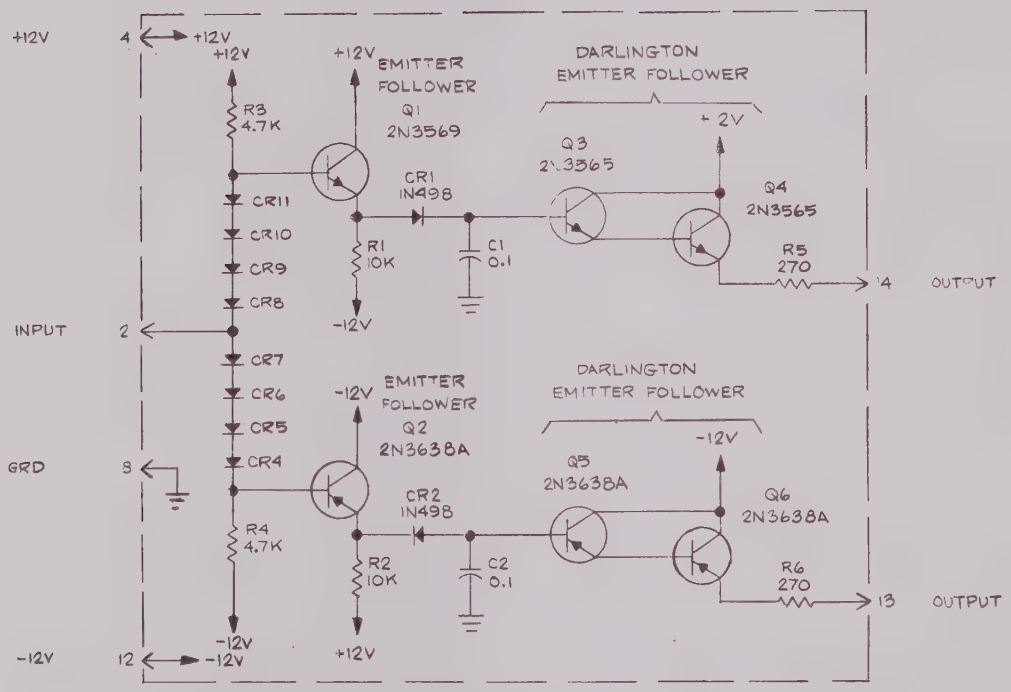
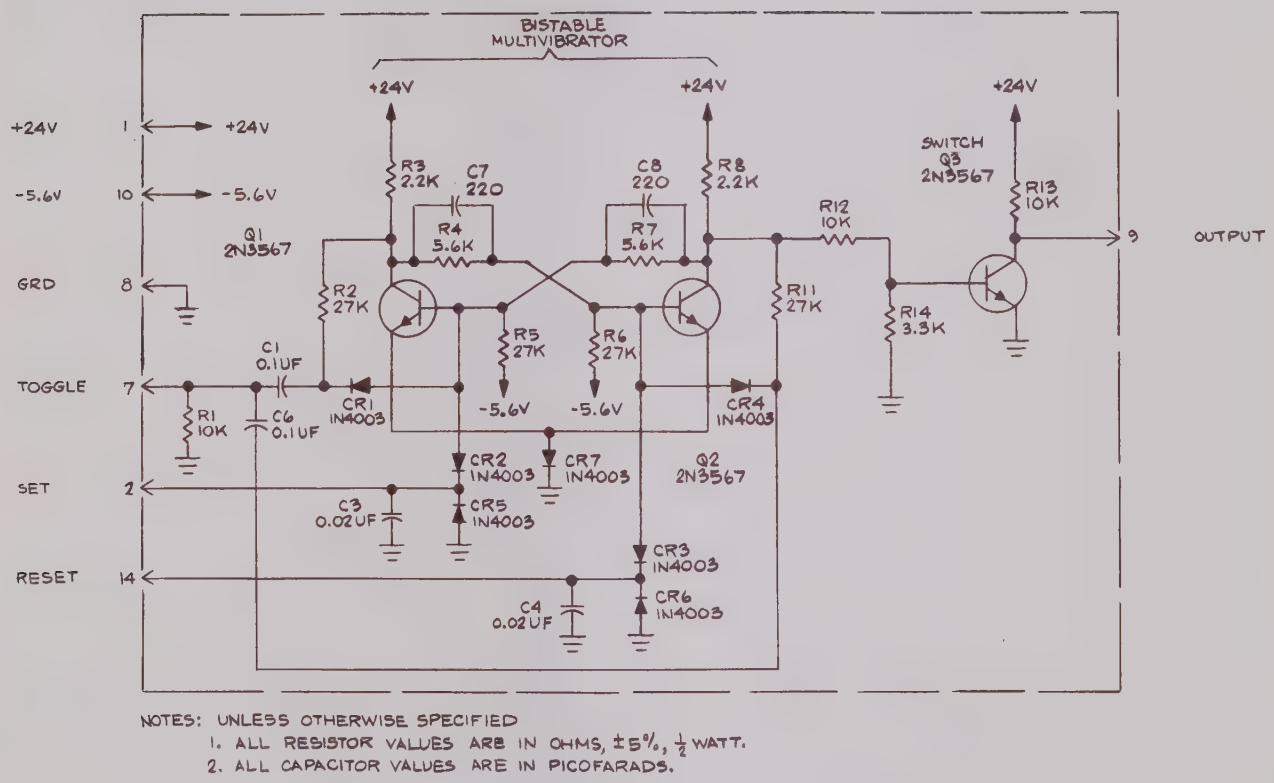


Figure 5-15. Slideback/Video Stretch Amplifier A210, Schematic Diagram



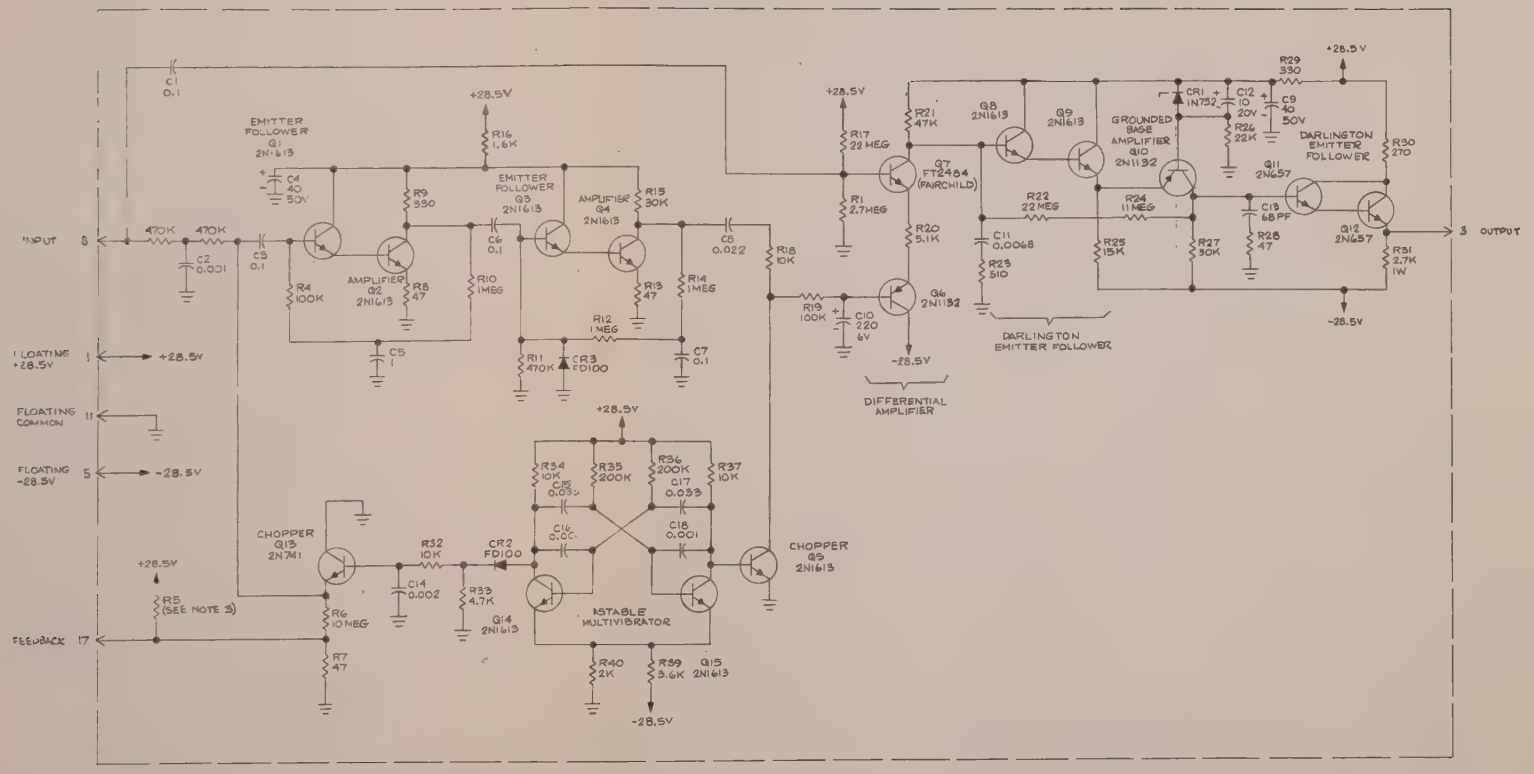
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES ARE IN OHMS, ±5%, $\frac{1}{2}$ WATT.
2. ALL CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL DIODES ARE TYPE IN4003.

Figure 5-16. Afc Bipolar Pulse Stretcher A211, Schematic Diagram



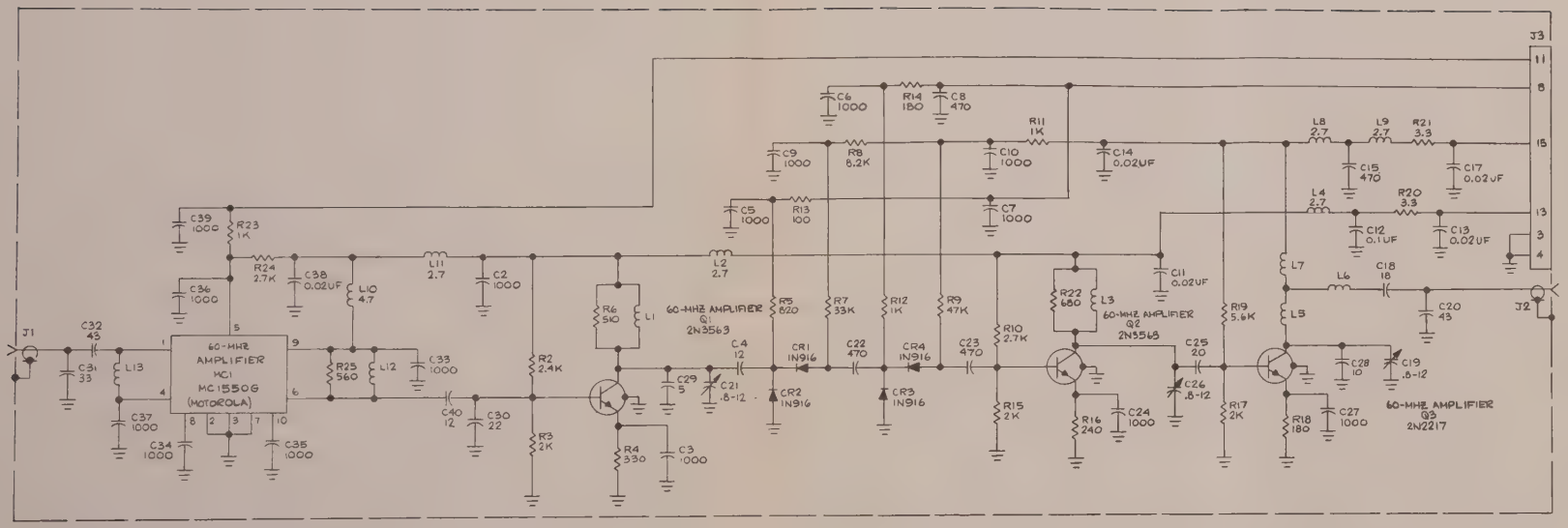
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.

Figure 5-17. Scan Direction Control Flip-flop A212, Schematic Diagram



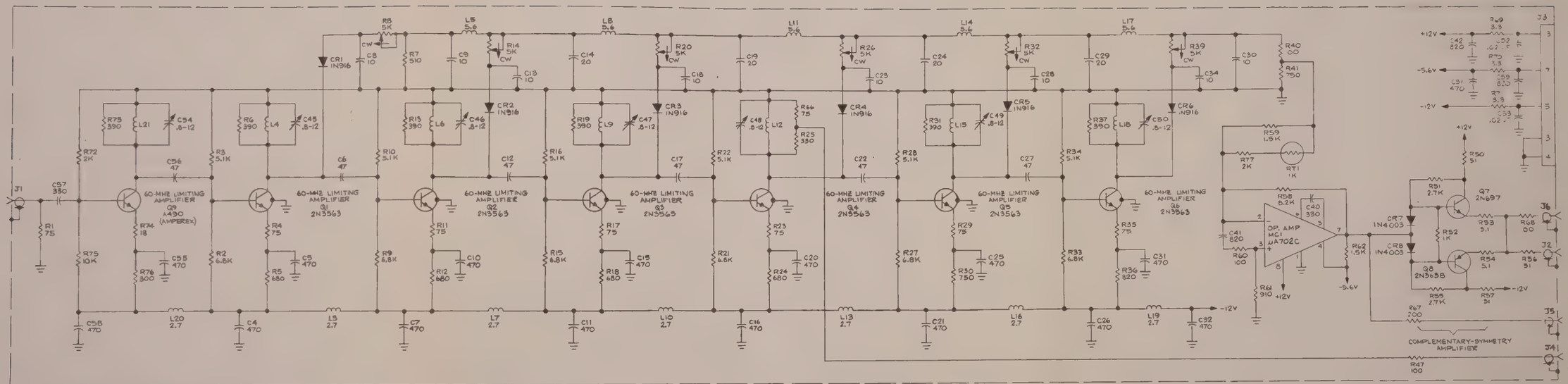
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.
3. SELECTED TO BALANCE INITIAL OFFSET.

Figure 5-18. Peak Operational Amplifier A217, Schematic Diagram



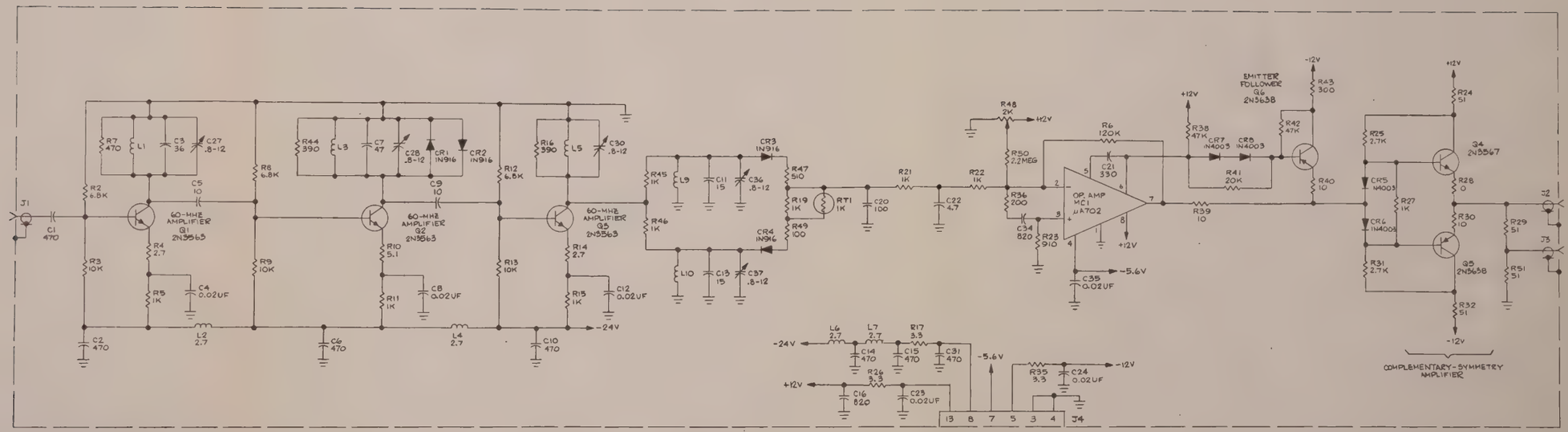
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, $\frac{1}{4}$ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. ALL INDUCTOR VALUES ARE IN MICROHENRIES.

Figure 5-19. 60-MHz Linear I-f Amplifier A220, Schematic Diagram



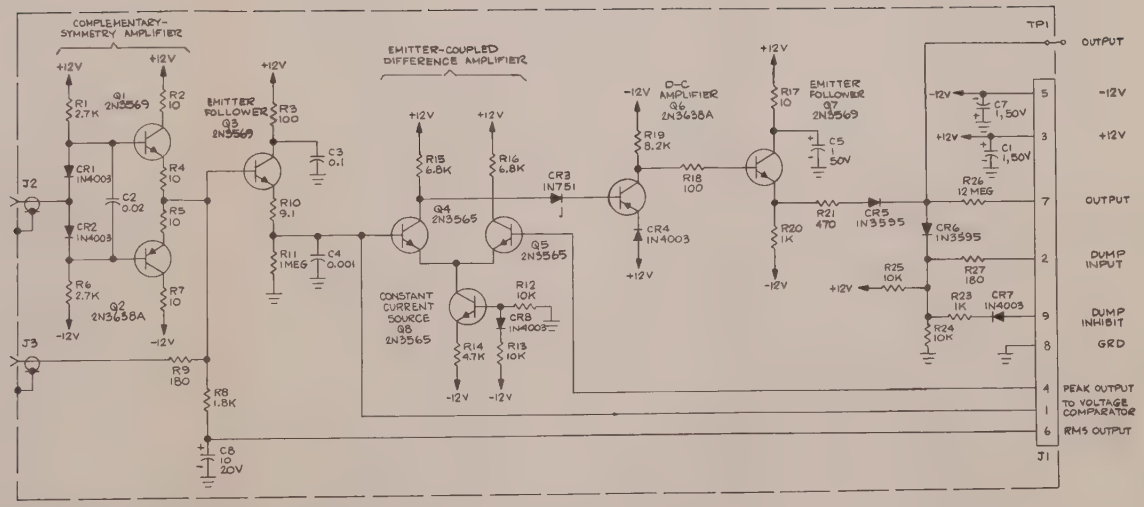
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ¼ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. ALL INDUCTOR VALUES ARE IN MICROHENRIES.

Figure 5-20. 60-MHz Logarithmic I-f Amplifier A221, Schematic Diagram



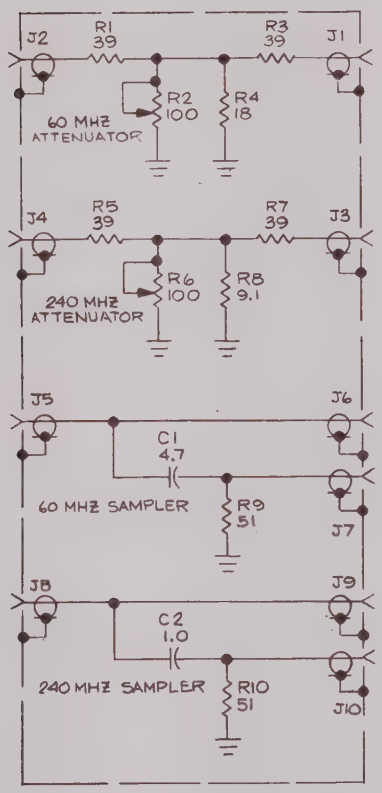
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ¼ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. ALL INDUCTOR VALUES ARE IN MICROHENRIES.

Figure 5-21. 60-MHz I-f Amplifier/Afc Discriminator A222, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ¼ WATT.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

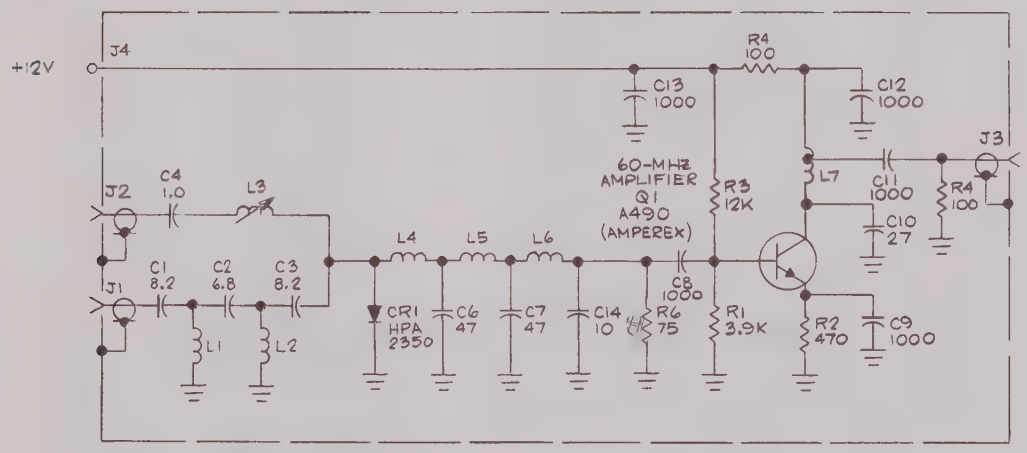
Figure 5-22. Video Buffer/Peak Driver Amplifier A223, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED

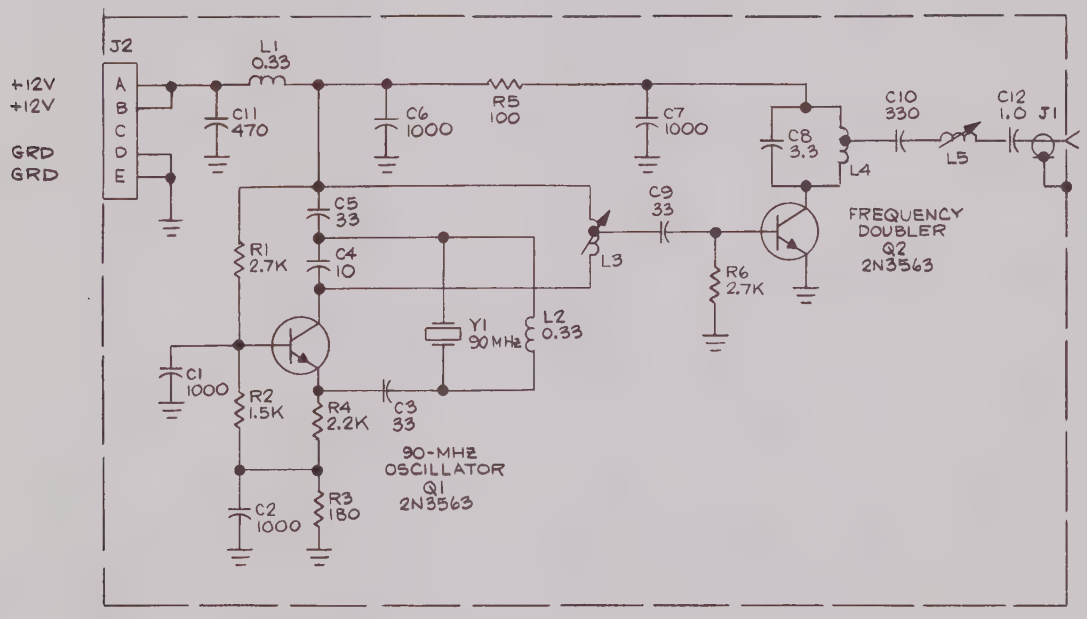
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, ½ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.

Figure 5-23. Signal Samplers/I-f Attenuators A224, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, $\frac{1}{4}$ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.

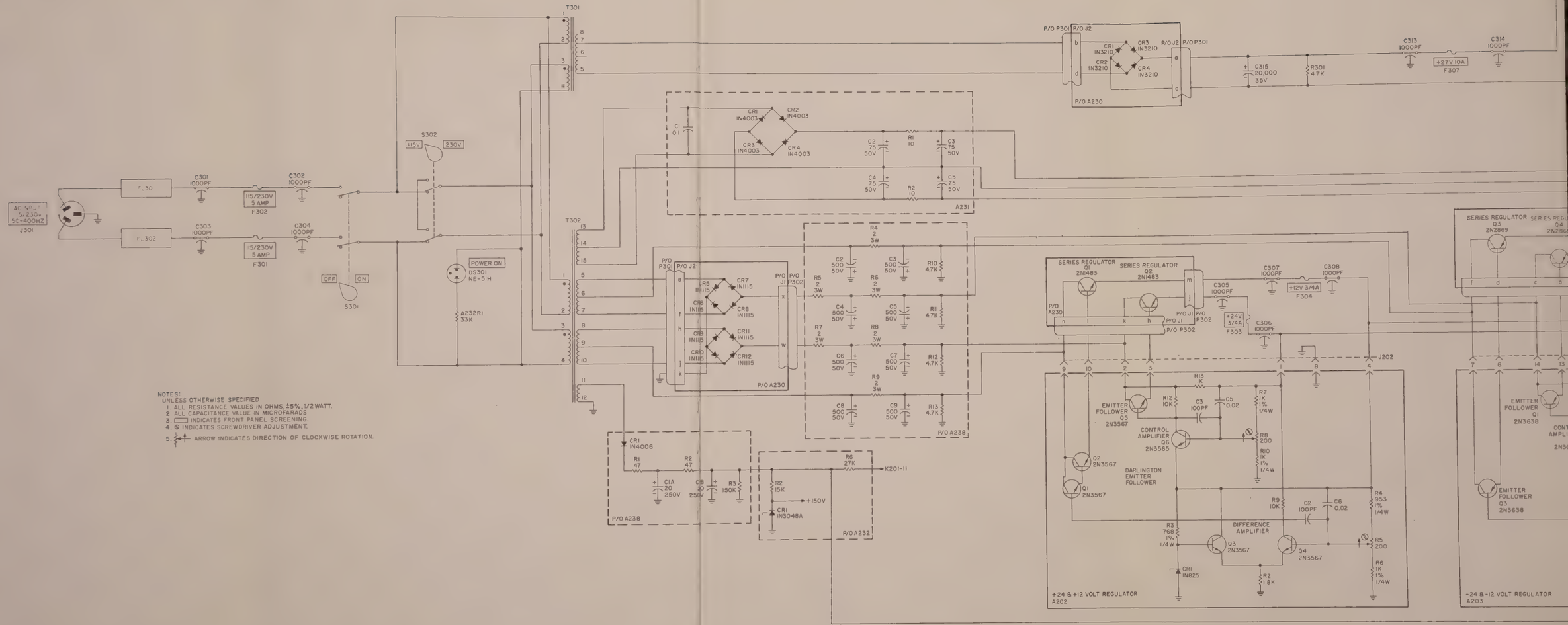
Figure 5-24. 240/60-MHz Mixer A225, Schematic Diagram



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS, ±5%, $\frac{1}{4}$ WATT.
2. ALL CAPACITOR VALUES ARE IN PICOFARADS.
3. ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 5-25. Crystal-Controlled Oscillator A226, Schematic Diagram



NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTANCE VALUES IN OHMS, ±5%, 1/2 WATT.
2. ALL CAPACITANCE VALUE IN MICROFARADS.
3. ▭ INDICATES FRONT PANEL SCREENING.
4. Ⓢ INDICATES SCREWDRIVER ADJUSTMENT.
5. ARROW INDICATES DIRECTION OF CLOCKWISE ROTATION.

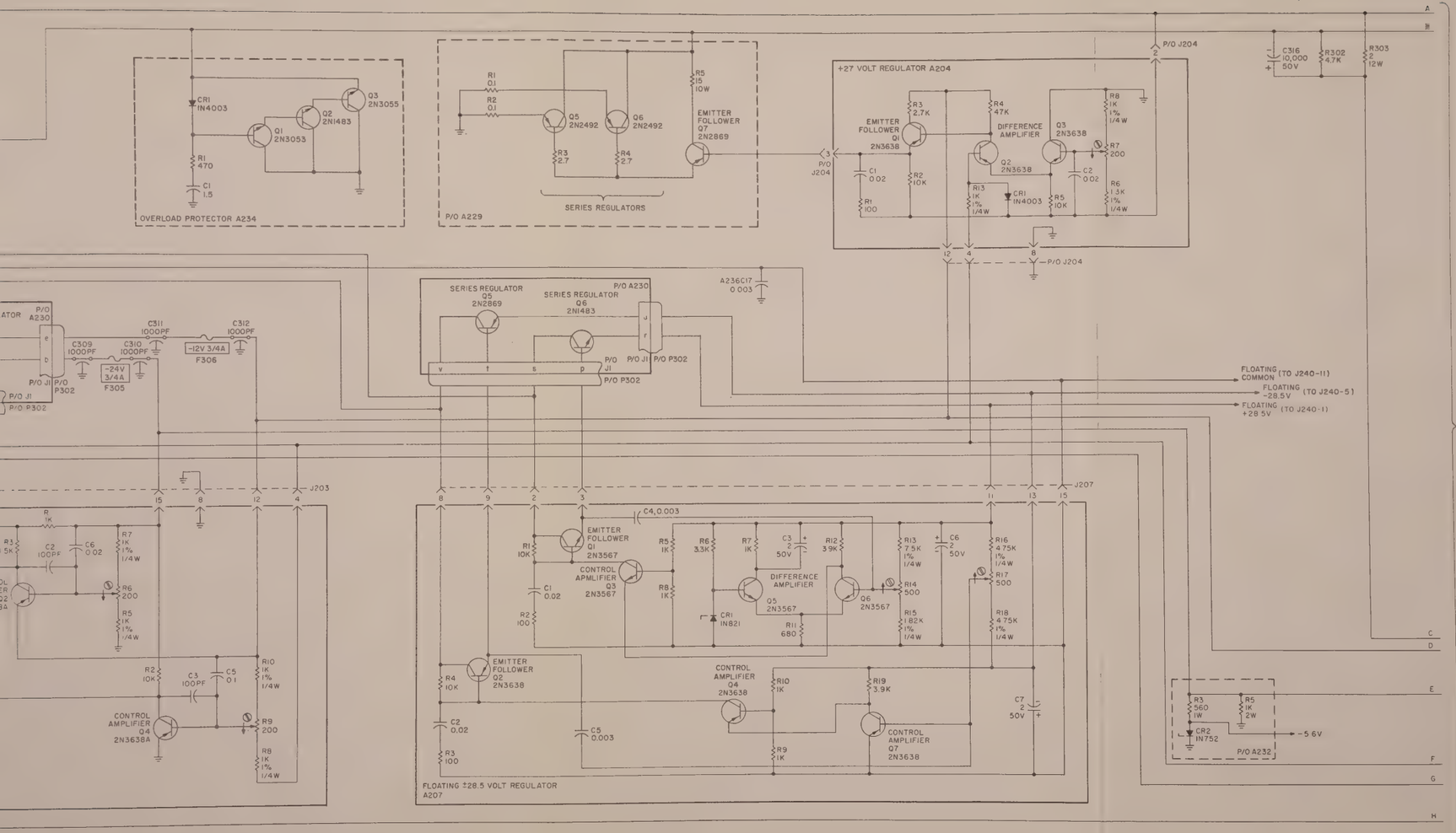


Figure 5-26. Data Evaluation Unit Power Supplies, Composite Schematic and Interassembly Wiring Diagram (Sheet 1 of 2)

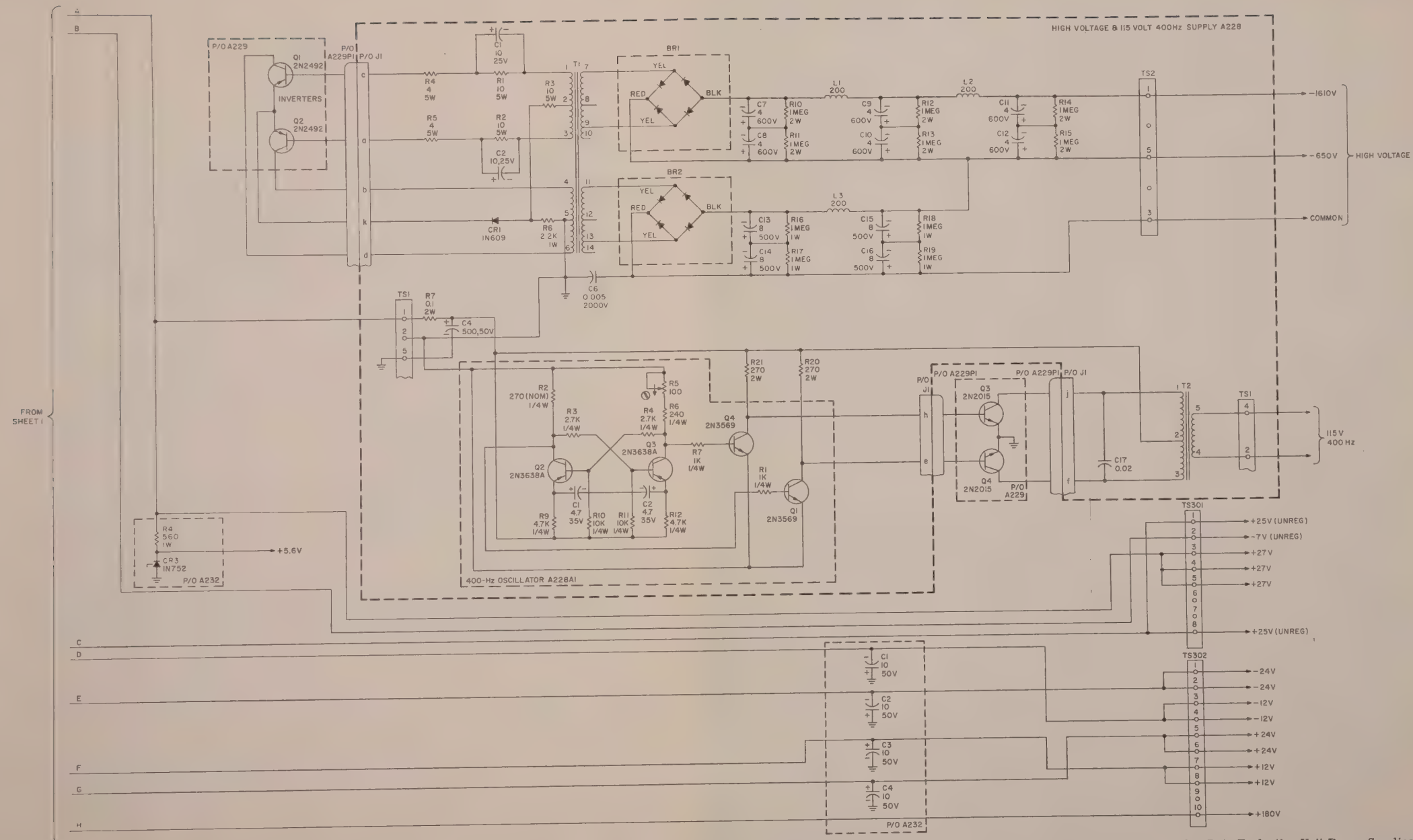


Figure 5-26. Data Evaluation Unit Power Supplies, Composite Schematic and Interassembly Wiring Diagram (Sheet 2 of 2)

SECTION VI
PARTS LIST

6-1. INTRODUCTION.

6-2. This parts list section includes all pertinent data necessary to locate, identify, and procure additional parts for the equipment. Parts are listed alpha-numerically by reference symbol and include all replaceable items such as electronic, electromechanical, and mechanical parts of the equipment. In some cases, values, ratings and manufacturer sources shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement of the part(s) removed from the equipment.

6-3. ORDERING INFORMATION.

6-4. The following instructions will aid in ordering parts from the Parts List, table 6-2:

a. Address all inquiries or orders to:

CUSTOMER SERVICE
EMC Instrumentation, Inc.
7338 Varna Avenue
North Hollywood, Calif. 91605

b. Include the following information:

1) Model and Serial Number of instrument.

2) EMC Part Number.

3) Reference Symbol Number.

4) Description (as shown on list).

6-5. HOW TO USE THE PARTS LIST.

6-6. Paragraphs 6-7 through 6-11 describe the use and meaning of the five columns included in the parts list, table 6-2 (see figure 6-1).

6-7. REF SYMBOL COLUMN. The Ref Symbol Column (1, figure 6-1) contains an alpha-numerical listing of parts as they appear on equipment chassis, illustration, or schematic. The reference designation identifies the parts as to their component function in the instrument.

6-8. DESCRIPTION COLUMN. The Description Column (2, figure 6-1) contains the identification of component parts including all pertinent specifications and Singer Part Number. When the description column is used for a part which is identical to a part which has already been described; SAME AS (3) is used along with the reference symbol of the previously used part. In these instances, columns 3, 4, 5 are left blank. When the description column is used for a reference symbol for which no part exists; NOT USED (4) is placed in the column. In these instances, columns 3, 4, 5, are left blank.

6-9. MANUFACTURER'S PART NUMBER COLUMN. The Manufacturer's Part Number column (5, figure 6-1) contains the part number as designated by the manufacturer of the part.

6-10. MFR'S CODE COLUMN. The Mfr's Code column (6, figure 6-1) references the manufacturer by an assigned code number as listed in Federal Supply Code Handbook H4-2. For manufacturers not listed in H4-2, a letter code will be assigned. Table 6-1 includes the manufacturer and his code designation.

6-11. MAINT QTY COLUMN. The Maint Qty column, (7, figure 6-1) contains the number of additional components recommended to keep the equipment at an optimum performance level. The recommended number of components in the Maint Qty column is based on 2000 hours of equipment operation.

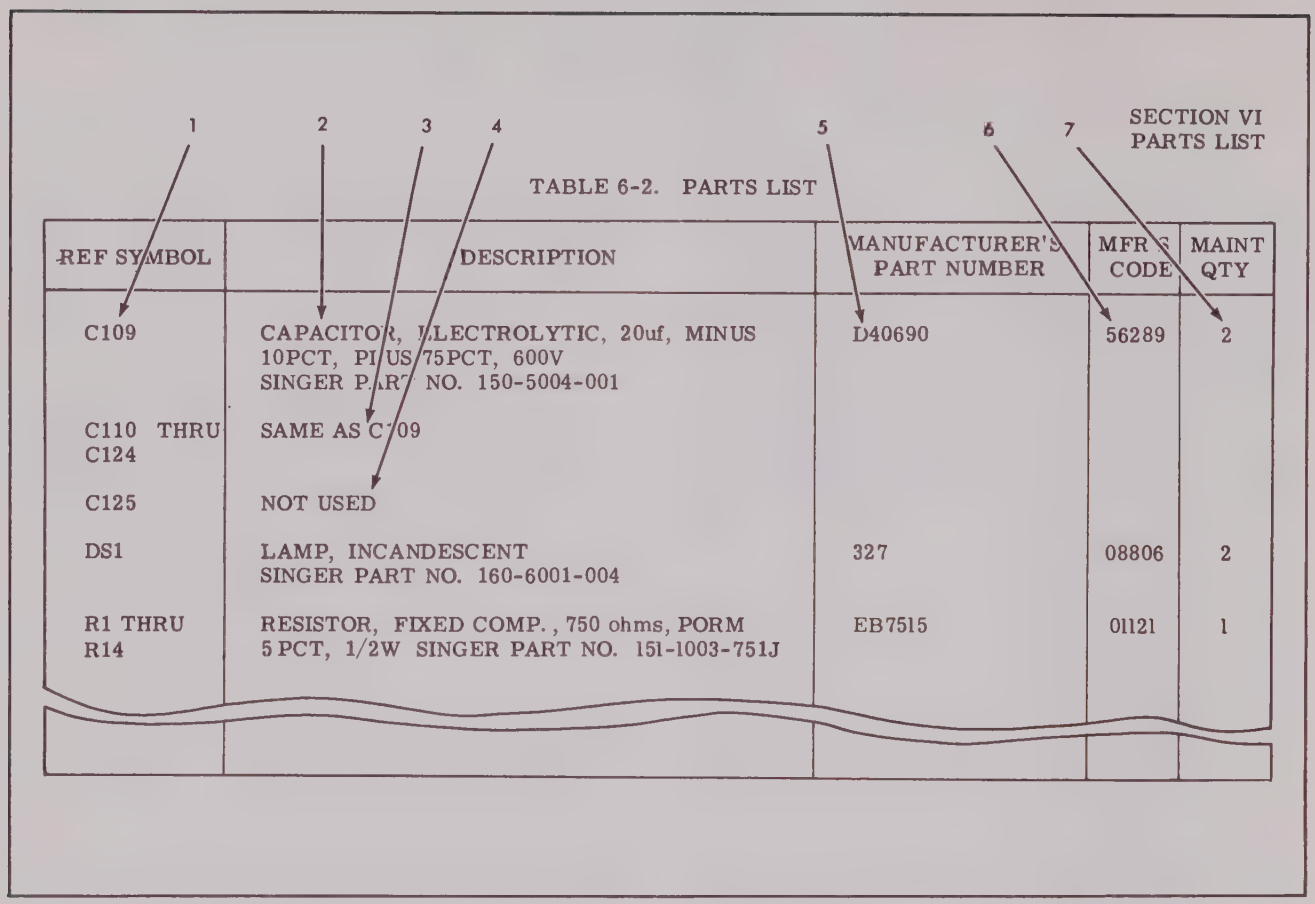


Figure 6-1. Parts List Sample

TABLE 6-1. MANUFACTURER'S CODE

Number	Name
00373	Garlock Inc. Electronic Products Div. Camden, N.J.
00656	Aerovox Corp. New Bedford, Mass.
01121	Allen-Bradley Co. Milwaukee, Wis.
01295	Texas Instruments Inc. Semiconductor-Components Division Dallas, Tex.
02660	Amphenol-Borg Electronics Corp. Maywood, Ill.
02735	Radio Corporation of America Commercial Receiving Tube and Semiconductor Division Somerville, N.J.
04009	Arrow-Hart & Hegeman Electric Co. Hartford, Conn.
04713	Motorola Inc. Semiconductor Products Division Pheonix, Ariz.
05397	Union Carbide Corp. Linde Division, Kemet Dept. Cleveland, Ohio
05574	Viking Industries Inc. Chatsworth, Calif.
07263	Fairchild Camera and Instrument Corp. Semiconductor Division Mountain View, Calif.
08699	Fae Instrument Corp. Huntington Station, N.Y.

TABLE 6-1. MANUFACTURER'S CODE (Cont'd)

Number	Name
09023	Cornell-Dubilier Electric Corp. Electrolytics and Paper Tubular Division Sanford, N.C.
09213	General Electric Co. Semiconductor Products Dept. Buffalo, N.Y.
11534	Duncan Electronics Inc. Costa Mesa, Calif.
12094	Raytheon Co. Microwave and Power Tube Division Burlington, Mass.
12143	Bendix Corp. Electrical Components Div. Santa Ana, Calif.
13866	Beam Tube Corp. Milford, Mass.
14099	Semtech Corp. Newbury Park, Calif.
14193	Californai Resistor Corp. Santa Monica, Calif.
15801	Fenwall Electronics Inc. Framingham, Mass.
17276	Nexus Research Laboratory Canton, Mass.
25313	EMC Instrumentation Inc Subsidiary of The Singer Company North Hollywood, Calif.
28480	Hewlett-Packard Co. Palo Alto, Calif.
30684	Industrial Products Co. Philadelphia, Pa.
40931	Honeywell Inc. Minneapolis, Minn.
53021	Sangamo Electric Co. Springfield, Ill.
63743	Ward Leonard Electric Co. Mount Vernon, N.Y.
70563	Amperite Co. Union City, N.J.
71468	ITT Cannon Electric Inc. Los Angeles, Calif.
71744	Chicago Miniature Lamp Works Chicago, Ill.
71785	Cinch Mfg. Co. and H. B. Jones Division Chicago, Ill.
73138	Beckman Instruments Inc. Helipot Division Fullerton, Calif.
73445	Amperex Electronic Co. Division of North American Philips Co, Inc. Hicksville, N.Y.
73899	JFD Electronics Corp. Brooklyn, N.Y.
74306	Piezo Crystal Co. Carlisle, Pa.
74970	E.F. Johnson Co. Waseca, Minn.
75915	Littelfuse Inc. Des Plaines, Ill.
77342	American Machine and Foundry Co. Potter and Brumfield Division Princeton, Ind.
79727	Continental-Wirt Electronics Corp. Philadelphia, Pa.
80183	Sprague Products Co. North Adams, Mass.
80294	Bourns Inc. Riverside, Calif.
81095	Triad Transformer Corp. Venice, Calif.
81312	Winchester Electronics Division Litton Industries Inc. Oakville, Conn.
81349	Military Specifications
81483	International Rectifier Corp. El Segundo, Calif.
81640	Control Company of America Control Switch Division Folcroft, Pa.
81840	Ledex Inc. Dayton, Ohio

TABLE 6-1. MANUFACTURER'S CODE (Cont'd)

Number	Name
82152	Transco Products Inc. Venice, Calif.
84171	Arco Electronics Inc. Great Neck, N.Y.
86151	Genisco Technology Corp. Illinois Division Rosemont, Ill.
91662	Elco Corp. Willow Grove, Pa.
91737	Gremar Mfg. Co. Inc. Wakefield, Mass.
93332	Sylvania Electric Products Inc. Semiconductor Products Division Woburn, Mass.
94375	Automatic Metal Products Corp. Brooklyn, N.Y.
98291	Sealectro Corp. Mamaroneck, N.Y.
99515	Marshall Industries Electron Products Division San Marino, Calif.
99800	Delevan Electronics Corp. East Aurora, N.Y.
99899	Narda Microwave Corp. Plainview, N.Y.

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
AT101	ATTENUATOR,COAXIAL, 40DB EMC PART NO. 30025-40	757-40	99899	1
AT101J1	CONNECTOR,JACK,NON-REPLACEABLE PART OF AT101			
AT101P1	CONNECTOR,PLUG,NON-REPLACEABLE PART OF AT101			
AT102	ATTENUATOR,COAXIAL, 6DB EMC PART NO. 30025-6	757-6.	99899	1
AT102J1	CONNECTOR,JACK,NON-REPLACEABLE PART OF AT102			
AT102P1	CONNECTOR,PLUG,NON-REPLACEABLE PART OF AT102			
AT103	ISOLATOR 4 TO 7 GHZ EMC PART NO. 30900	C17N	18203	1
AT103J1	CONNECTOR,JACK,NON-REPLACEABLE PART OF AT103			
AT103P1	CONNECTOR,PLUG,NON-REPLACEABLE PART OF AT103			
AT104	ISOLATOR, 7 TO 11 GHZ EMC PART NO. 30901	CX15N	18203	1
AT104J1	CONNECTOR,JACK,NON-REPLACEABLE PART OF AT104			
AT104P1	CONNECTOR,PLUG,NON-REPLACEABLE PART OF AT104			
CR101 THRU CR108	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-4003	1N4003	04713	1
CR112	SAME AS CR101			
CR125 THRU CR133	SAME AS CR101			
C119	CAPACITOR,FIXED,0.02 UF,100V EMC PART NO. 30057-203	THS-20	80183	7
C120	CAPACITOR,FIXED,ELECTROLYTIC, 10000UF,50V EMC PART NO. 30072-103M	539-2650-01	53021	1
C121	CAPACITOR,FIXED,ELECTROLYTIC, 1 UF,PLUS 150 MINUS 10 PCT,50V EMC PART NO. 30050-105	NLW-1-50	09023	1
C122 THRU C125	CAPACITOR,FIXED,CERAMIC DISC, 0.02UF,500V EMC PART NO. 30070-203	5HK-520	80183	1
C126 AND C127	SAME AS C119			
C128 AND C129	CAPACITOR,ELECTROLYTIC, 2UF,PLUS 150 MINUS 10 PCT,50V EMC PART NO. 30050-205	NLW-2-50	09023	1
C130	SAME AS C121			
C135 AND C136	CAPACITOR,FIXED,TANTALUM, 10UF,PORM 20 PCT, 20V EMC PART NO. 30060-100M-20	K10C20K	05397	1
C137 AND C138	CAPACITOR,FIXED,CERAMIC DISC, 0.001 UF, PORM 20 PCT,1000V EMC PART NO. 30058-102	5GA-D10	80183	1
J105	CONNECTOR,JACK	80249-1	25313	1
J141	CONNECTOR,JACK, 55 PIN EMC PART NO. 30441	PC-07R-2-55P	12143	1
J142 THRU J147	CONNECTOR,JACK, 15PIN EMC PART NO. 30428-15	VK155/1	05574	1

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
J148-1 THRU J148-8	JACK,PIN EMC PART NO. 30643-2	SKT-22	98291	1
J155	CONNECTOR,JACK EMC PART NO. 304501	101-T3100-75	94375	1
K101 THRU K110	RELAY,4PDT,24VDC EMC PART NO. 30351	KHP17D11	77342	1
L101A AND L101B	SOLONOID,ROTARY ACTUATOR, 26 VDC EMC PART NO. 30725	215248-026	81840	1
P101 THRU P104	CONNECTOR,PLUG, 20 PIN EMC PART NO. 30432-20	MRE205	81312	1
P149	SAME AS P101			
Q101 AND Q102	TRANSISTOR EMC PART NO. 30550-1483	2N1483	02735	1
R101	RESISTOR,FIXED,WIRE-WOUND, 2 OHM,PORM 5 PCT, 12 W EMC PART NO. 30005-20A	1705	44655	1
R102 AND R103	RESISTOR,FIXED,COMP., 47 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-470	EB4705	01121	1
R104	RESISTOR,FIXED,COMP., 39K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-393	EB3935	01121	1
R105	RESISTOR,FIXED,COMP., 27K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-273	EB2735	01121	1
R106	SAME AS R104			
R107	RESISTOR,FIXED,COMP., 10K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-103	EB1035	01121	3
R108	RESISTOR,VARIABLE, 100K EMC PART NO. 30258-104	75P100K	73138	1
R109 AND R110	RESISTOR,FIXED,COMP., 22K OHMS,PORM 5 PCT 1/2W EMC PART NO. 30001-223	EB2235	01121	1
R111	RESISTOR,FIXED,COMP., 180 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-181	EB1815	01121	1
S101	SWITCH,ROTARY, 4 POS., 8 SEC.	30282	25313	1
S102	SWITCH,COAXIAL, SP4T, 28VDC EMC PART NO. 30352	1460-4	82152	1
S102J1 THRU J5	CONNECTOR,JACK,NON-REPLACEABLE PART OS S102			
TB101	TERMINAL BOARD	80242-1	25313	1
TS101	TERMINAL STRIP, 10 POS	30438-9-1	25313	1
TS102 AND TS103	TERMINAL STRIP, 5 POS. EMC PART NO. 30449-5	5-170	71785	1
W101	CABLE ASSY	80156-3	25313	1
W101P1 AND P2	CONNECTOR,PLUG EMC PART NO. 30426-21	UG-21D/U	02660	1
W102	CABLE ASSY	80156-2	25313	1

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
W102P1 AND P2	SAME AS W101P1			
W103	CABLE ASSY	80156-4	25313	1
W103P1 AND P2	SAME AS W101P1			
W104	CABLE ASSY	80181-1	25313	1
W104P1	CONNECTOR,PLUG EMC PART NO. 30426-22	UG-220/U	02660	1
W104P2	SAME AS W101P1			
W109	CABLE ASSY	80155-2	25313	1
W109P1 AND P2	CONNECTOR,PLUG EMC PART NO. 30450-3	101-B2800	94375	1
W110	CABLE ASSY	80155-1	25313	1
W110P1 AND P2	SAME AS W109P1			
W111	CABLE ASSY	80155-3	25313	1
W111P1 AND P2	SAME AS W109P1			
W112	CABLE ASSY	80155-4	25313	1
W112P1 AND P2	SAME AS W109P1			
W113	CABLE ASSY	80158-1	25313	1
W113P1	SAME AS W109P1			
W114	CABLE ASSY	80160-1	25313	1
W114P1	SAME AS W101P1			
Z101	SWITCH,COAXIAL, SP2T,28VDC EMC PART NO. 30354	11100	82152	1
Z101J1 THRU J3	CONNECTOR,JACK,NON-REPLACEABLE PART OF Z101			
Z102	SWITCH,COAXIAL, SP4T,28VDC EMC PART NO. 30353	14100	82152	1
Z102J1 THRU J5	CONNECTOR,JACK,NON-REPLACEABLE PART OF Z102			
Z103	SWITCH,COAX,SP4T,28VDC	80386-1	25313	1
Z103J1 THRU J5	CONNECTOR,JACK,NON-REPLACEABLE PART OF Z103			
Z104	IMPULSE GENERATOR ASSY	80234-1	25313	1
Z104J1	CONNECTOR,JACK,NON-REPLACEABLE PART OF Z104			
A101	AFC PULSE AMPLIFIER	80107-1	25313	1
A101CR1	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-3044A	1N3044A	01295	1

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A101C1	CAPACITOR,FIXED,METALIZED MYLAR, 0.1 UF,200V EMC PART NO. 30062-104	D2-104	99515	1
A101C2	SAME AS C119			
A101C3	SAME AS C121			
A101Q1	TRANSISTOR EMC PART NO. 30550-3565	2N3565	07263	1
A101Q2	TRANSISTOR EMC PART NO. 30550-40327	40327	02735	1
A101R1	RESISTOR,FIXED,COMP., 100 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-101	EB1015	01121	1
A101R2	RESISTOR,VARIABLE, 20 K OHMS EMC PART NO. 30250-203	3067P-203	80294	1
A101R3	RESISTOR,FIXED,COMP., 1K OHM,PORM 5 PCT,1/2W EMC PART NO. 30001-102	EB1025	01121	2
A101R4	SAME AS R107			
A101R5	RESISTOR,FIXED,COMP., 470 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-471	EB4715	01121	1
A101R6	SAME AS A101R3			
A101R7	RESISTOR,FIXED,COMP., 18K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-183	EB1835	01121	1
A101R8	RESISTOR,FIXED,COMP., 220K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-224	EB2245	01121	1
A101R9	SAME AS R111			
A101R10	SAME AS R107			
A101R11	RESISTOR,FIXED,COMP., 1MEGOHM,PORM 5 PCT, 1/2W EMC PART NO. 30001-105	EB1055	01121	2
A101R12	SAME AS A101R1			
A102	CLOCK OSCILLATOR	80113-1	25313	1
A102C1 AND C2	CAPACITOR,FIXED,TANTALUM, 10 UF,PORM 10 PCT, 20V EMC PART NO. 30060-100M-20	K10C20K	05397	1
A102Q1 AND Q2	TRANSISTOR EMC PART NO. 30550-4360	2N4360	07263	1
A102Q3	SAME AS A101Q1			
A102Q4	TRANSISTOR EMC PART NO. 30050-3569	2N3569	07263	1
A102R1	RESISTOR,FIXED,COMP., 820 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-821	EB8215	01121	1
A102R2	RESISTOR,FIXED,COMP., 8.2K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-822	EB8225	01121	2
A102R3	RESISTOR,FIXED,COMP., 33K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-333	EB3335	01121	2
A102R4	SAME AS A101R7			
A102R5	SAME AS A102R2			

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A102R6	RESISTOR,FIXED,COMP., 100K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-104	EB1045	01121	3
A102R7	RESISTOR,FIXED,COMP., 5.6K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-562	EB5625	01121	2
A103	SERVO BIPOLAR CHOPPER / PREAMPLIFIER	80115-1	25313	1
A103CR1 THRU CR4	SAME AS CR101			
A103C4	CAPACITOR,FIXED,METALIZED MYLAR, 0.22 UF, PORM 20 PCT,200V EMC PART NO. 30062-224	D2-224	99515	1
A103C5 THRU C7	SAME AS C128			
A103Q1	TRANSISTOR EMC PART NO. 30550-3567	2N3567	07263	1
A103Q2	TRANSISTOR EMC PART NO. 30550-3638	2N3638	07263	1
A103Q3 THRU Q5	SAME AS A103Q1			
A103R2	SAME AS R107			
A103R3	SAME AS A102R3			
A103R4	SAME AS R107			
A103R5	SAME AS A102R7			
A103R6	SAME AS A102R3			
A103R7	SAME AS R105			
A103R8 THRU R14	SAME AS R107			
A103R15 AND R16	SAME AS A101R3			
A103R17	RESISTOR,FIXED,COMP., 1.5K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-152	EB1525	01121	2
A103R18 AND R19	RESISTOR,FIXED,COMP., 2.7K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-272	EB2725	01121	2
A103R20	SAME AS A103R17			
A104	IMPULSE GENERATOR DRIVER	80116-1	25313	1
A104CR1	SAME AS CR101			
A104C1 AND C2	SAME AS A102C1			
A104Q1 AND Q2	SAME AS A103Q2			
A104Q3	SAME AS A101Q1			
A104Q4	SAME AS A103Q1			
A104R1	SAME AS A102R2			
A104R2	SAME AS A103R17			

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A104R3	RESISTOR,FIXED,COMP., 680 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-681	EB6815	01121	1
A104R4	SAME AS A103R17			
A104R5 AND R6	SAME AS R107			
A104R7	SAME AS A102R2			
A104R8	SAME AS A104R3			
A104R9	RESISTOR,FIXED,COMP., 10 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-100	EB1005	01121	1
A104R10	SAME AS A101R3			
A105	X ANALOG VOLTAGE TRACKING ADJUSTMENTS	80117-1	25313	1
A105R1	RESISTOR,FIXED,FILM, 11.8K OHMS,PORM 1 PCT 1/2W EMC PART NO. 30014-1182	RN65D1182F	79727	1
A105R2 AND R3	RESISTOR,VARIABLE, 2K OHMS EMC PART NO. 30250-202	3067P-202	80294	1
A105R4	RESISTOR,FIXED,FILM, 1K OHM,PORM 1 PCT,1/2W EMC PART NO. 30014-1001	RN65D1001F	79727	1
A105R5	RESISTOR,FIXED,FILM, 10K OHMS,PORM 1 PCT, 1/2W EMC PART NO. 30014-1002	RN65D1002F	79727	1
A105R6	SAME AS A105R2			
A105R7	RESISTOR,FIXED,FILM, 5.11K OHMS,PORM 1 PCT, 1/2W EMC PART NO. 30014-5111	RN65D5111F	79727	1
A105R8	SAME AS A105R2			
A105R9	RESISTOR,FIXED,FILM, 2.49K OHMS,PORM 1 PCT, 1/2W EMC 30014-2491	RN65D2491F	79727	1
A105R10	RESISTOR,FIXED,FILM, 4.75K OHMS,PORM 1 PCT, 1/2W EMC PART NO. 30014-4751	RN65D4751F	79727	1
A105R11	SAME AS A105R2			
A105R12	RESISTOR,FIXED,FILM, 8.25K OHMS,PORM 1 PCT, 1/2W EMC PART NO. 30014-8251	RN65D8251F	79727	1
A105R13	SAME AS A105R2			
A105R14	SAME AS A105R7			
A105R15	SAME AS A105R2			
A105R16	SAME AS A105R5			
A105R17	SAME AS A105R2			
A105R18	SAME AS A105R12			
A106	AFC BIPOLAR CHOPPER	80118-1	25313	1
A106CR1 AND CR2	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-498	1N498	93332	1
A106C1 AND C2	SAME AS C119			

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A106C6	CAPACITOR,FIXED,METALLIZED MYLAR, 0.0068UF, PORM 20 PCT,100V EMC PART NO. 30063-682	D1-682	99515	1
A106Q1	SAME AS A103Q1			
A106Q2	SAME AS A103Q2			
A106Q4 THRU Q6	SAME AS A103Q2			
A106Q7	SAME AS A103Q1			
A106R2	SAME AS R107			
A106R10	SAME AS A103R18			
A106R11	RESISTOR,FIXED,COMP., 1.8K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-182	EB1825	01121	1
A106R12	RESISTOR,FIXED,COMP., 270 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-271	EB2715	01121	1
A106R13	RESISTOR,FIXED,COMP., 1.2K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-122	EB1225	01121	1
A106R14 AND R15	SAME AS A102R7			
A106R16	SAME AS R107			
A106R17	SAME AS A106R13			
A106R18	SAME AS A106R12			
A106R19	SAME AS A103R18			
A107	PREAMPLIFIER,240 MHZ BAND 1	80366-1	25313	1
A107C1 AND C2	CAPACITOR,FIXED,CERAMIC DISC, 330 PF,1000V EMC PART NO. 30058-331	5GA-T33	80183	1
A107C3	CAPACITOR,FEED-THRU, 1000 PF EMC PART NO. 30075-102	FA5C-102	01121	1
A107C4	CAPACITOR,STANDOFF, 1000 PF EMC PART NO. 30074-102	SS5A-102	01121	1
A107C5	SAME AS A107C3			
A107C6	CAPACITOR,VARIABLE, 1 TO 10PF,500V EMC PART NO. 30083	VC950	73899	1
A107C7	SAME AS A107C1			
A107C8	SAME AS A107C4			
A107C9	SAME AS A107C3			
A107C10	SAME AS A107C6			
A107C11	SAME AS A107C1			
A107C12	SAME AS A107C3			
A107J1	CONNECTOR,JACK EMC PART NO. 30426-928	UG928/U	81349	1
A107L1	COIL,RF	90272-5	25313	1

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A107L2	COIL,RF	80272-18	25313	1
A107L3	COIL,RF ASSY	80416-5	25313	1
A107L4	SAME AS A107L2			
A107L5	SAME AS A107L3			
A107L6	SAME AS A107L1			
A107L7	COIL,RF,ASSY	80416-2	25313	1
A107L8	SAME AS A107L3			
A107L9	COIL,RF	80272-3	25313	1
A107Q1	TRANSISTOR EMC PART NO. 30550-490	A490	73445	1
A107Q2	TRANSISTOR EMC PART NO. 2N3563	2N3563	07263	1
A107R1	RESISTOR,FIXED,COMP., 51 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-510	CB5105	01121	1
A107R2 AND R3	RESISTOR,FIXED,COMP., 10K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-103	CB1035	01121	1
A107R4	RESISTOR,FIXED,COMP., 3.9K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-392	CB3925	01121	1
A107R5	RESISTOR,FIXED,COMP., 680 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-681	CB6815	01121	1
A107R6	RESISTOR,FIXED,COMP., 100 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-101	CB1015	01121	1
A107R7	RESISTOR,FIXED,COMP., 2.2K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-222	CB2225	01121	1
A107R8	RESISTOR,FIXED,COMP., 2K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-202	CB2025	01121	1
A107R9	RESISTOR,FIXED,COMP., 390 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-391	CB3915	01121	1
A107R10	RESISTOR,FIXED,COMP., 820 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-821	CB8215	01121	1
A107R11	SAME AS A107R6			
A107R12	SAME AS A107R1			
A107TP1	TERMINAL,FEED-THRU EMC PART NO. 30639	FT-SM-19	98291	1
A108 THRU A110	SAME AS A107			
A111	BALANCED MIXER,BAND 1	80299-1X	25313	1
A111CR1 AND CR2	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30599-416G	1N416G	93332	1
A111J1 AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF A111			
A112	BALANCED MIXER,BAND 2	80299-2X	25313	1
A112CR1 AND CR2	SAME AS A111CR1			

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A112J1 AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF A112			
A113	BALANCED MIXER,BAND 3	80368-1	25313	1
A113CR1 AND CR2	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30599-415G	1N415G	93332	1
A113J1 AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF A113			
A114	BALANCED MIXER,BAND 4	80369-1	25313	1
A114CR1 AND CR2	SEMICONDUCTOR DEVICE,DIODE MATCHED PAIR EMC PART NO. 30599-5190	DS190-MR	93332	1
A114J1 AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF A114			
A115	AFC OPERATIONAL AMPLIFIER EMC PART NO. 80239-SQ10	SQ10	17276	1
A116	NOT USED			
A117	HIGH VOLTAGE REGULATORS	80150-1	25313	1
A117C1 AND C2	CAPACITOR,FIXED,CERAMIC DISC, 0.01 UF, PORM 20 PCT,1C00V EMC PART NO. 30069-103	5HKS10	80183	1
A117K1 THRU K4	RELAY,3PST,28VDC EMC PART NO. 30355	XP5092	91662	1
A117Q1	SAME AS A101Q1			
A117R1	RESISTOR,VARIABLE, 250 OHMS,PORM 10 PCT,1/2W EMC PART NO. 30254-251	AS3602	44655	1
A117R2	SAME AS A102R3			
A117TP1	JACK,TEST POINT,WHITE EMC PART NO. 30637	SKT-8	98291	1
A117V1	ELECTRON TUBE EMC PART NO. 30500-0A2	0A2	12094	1
A117V2 AND V3	ELECTRON TUBE EMC PART NO. 30500-0B2	0B2	12094	2
A117V4	SAME AS A117V1			
A117V5 AND V6	SAME AS A117V2			
A117V7	SAME AS A117V1			
A117XK1 THRU XK4	SOCKET,RELAY EMC PART NO. 30503	04-813-0	91662	1
A117XV1 THRU XV7	SOCKET,ELECTRON TUBE, 7 PIN EMC PART NO. 30501	04-703-0	91662	1
A118	KLYSTRON VOLTAGE ADJUSTMENTS	80147-1	25313	1
A118R1 THRU R8	RESISTOR,VARIABLE, 50K OHMS,0.9W	30256-503	25313	1
A118TP1	JACK,TEST POINT RED EMC PART NO. 30446-2	105-802	74970	1

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A118TP2	JACK,TEST POINT WHITE EMC PART NO. 30446-9	105-801	74970	1
A118TP3	JACK,TEST POINT YELLOW EMC PART NO. 30446-4	105-807	74970	1
A118TP4	JACK,TEST POINT BLACK EMC PART NO. 30446-0	105-803	74970	1
A118TP5	JACK,TEST POINT BLUE EMC PART NO. 30446-6	105-810	74970	1
A118TP6	SAME AS A118TP3			
A118TP7	SAME AS A118TP4			
A118TP8	SAME AS A118TP5			
A118TP9	SAME AS A118TP3			
A118TP10	SAME AS A118TP4			
A118TP11	SAME AS A118TP5			
A118TP12	JACK,TEST POINT GREEN EMC PART NO. 30446-5	105-804	74970	1
A118TP13	SAME AS A118TP3			
A118TP14	SAME AS A118TP4			
A118TP15	SAME AS A118TP5			
A119	AFC ADDER	80148-1	25313	1
A119CR1 THRU CR8	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-916	1N916	09213	1
A119CR9	SAME AS CR101			
A119CR10	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-1ZF18T10	1ZF18T10	81483	1
A119CR11 THRU CR14	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-4006	1N4006	04713	1
A119C1 THRU C8	SAME AS A117C1			
A119C9 THRU C16	CAPACITOR,FIXED,CERAMIC DISC, 0.01UF,PORM 5 PCT,2000V EMC PART NO. 30068-103	BL-S10	80183	1
A119R1 THRU R3	SAME AS A102R6			
A119R4	SAME AS A101R11			
A119R5 THRU R8	SAME AS A102R6			
A119R9	SAME AS A101R11			
A119R10 THRU R12	SAME AS A102R6			
A119R13	SAME AS A101R11			

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A119R14 THRU R17	SAME AS A102R6			
A119R18	SAME AS A101R11			
A119R19 AND R20	SAME AS A102R6			
A119R21 AND R22	RESISTOR,FIXED,COMP., 39K OHMS,PORM 5 PCT, 2W EMC PART NO. 30003-393	HB3935	01121	1
A119R23	SAME AS R105			
A119R24	SAME AS R107			
A119R25	RESISTOR,FIXED,COMP., 6.8K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-682	EB6825	01121	1
A119R26	RESISTOR,FIXED,COMP., 12K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-123	EB1235	01121	1
A120	NOT USED			
A121	SERVO DRIVE	80050-1	25313	1
A121B1	MOTOR,SERVO,400 CPS EMC PART NO. 80056-1	15M4DAC	08699	1
A121C1	CAPACITOR,FIXED,METALIZED MYLAR, 4 UF,100V EMC PART NO. 30063-405	D1-305	99515	1
A121J1	CONNECTOR,JACK, 20 PIN EMC PART NO. 30430-20	MRE-20J	81312	1
A121L1A THRU L3B	CLUTCH,DUPLEX,ELECTRO-MECHANICAL	80479-1	25313	1
A121R1	RESISTOR,FIXED,COMP., 1K OHM,PORM 5 PCT,1/2W EMC PART NO. 30003-102	HB1025	01121	1
A122	KLYSTRON FILAMENT SUPPLY	80410-1	25313	1
A122CR1 THRU CR16	SAME AS CR101			
A122C1 THRU C4	CAPACITOR,FIXED,ELECTROLYTIC, 1000 UF,10V EMC PART NO. 30084-102M	108G010FJ	80183	1
A122T1	TRANSFORMER,STEPDOWN	30157	25313	1
A123	NOT USED			
A124	TUNER,BAND1	80041-1	25313	1
A124FL1	FILTER,LOW PASS EMC PART NO. 80367-1	F130W	18203	1
A124FL1J AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF A124FL1			
A124J1	SAME AS A121J1			
A124R1	RESISTOR,VARIABLE, DUAL, 100K / 10K EMC PART NO. 30252	1600-620	11534	1
A124S1 AND S2	SWITCH,LIMIT ACTUATED,SPDT EMC PART NO. 30284	11SM1	40931	1
A124V1	ELECTRON TUBE KLYSTRON EMC PART NO. 30500-6BM6	6BM6	12094	1

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A124W1	CABLE ASSY	80579-1	25313	1
A124W1P1	CONNECTOR,PLUG EMC PART NO. 30426-536	UG-536B/U	02660	1
A124W1P2	CONNECTOR,PLUG EMC PART NO. 30447	35025	02660	1
A124W2	CABLE AND PROBE ASSY	80489-2	25313	1
A124W2P1	SAME AS A124W1P1			
A124W3	CABLE AND PROBE ASSY	80489-1	25313	1
A124W3P1	SAME AS A124W1P1			
A124W4	CABLE AND PROBE ASSY	80022-1	25313	1
A124W4P1	SAME AS A124W1P1			
A124XV1	CONNECTOR,PLUG, 4PIN EMC PART NO. 30451-4	91MPF-4L	02660	1
A124Z1	OSCILLATOR ASSY	80485	25313	1
A124Z2	PRESELECTOR ASSY	80483	25313	1
A125	TUNER,BAND 2	80041-2	25313	1
A125J1	SAME AS A121J1			
A125R1	SAME AS A124R1			
A125S1 AND S2	SAME AS A124S1			
A125V1	ELECTRON TUBE KLYSTRON EMC PART NO. 30500-6BL6	6BL6	12094	1
A125W1	CABLE AND PROBE ASSY	80490-1	25313	1
A125W1P1	SAME AS A124W1P1			
A125W2	CABLE AND PROBE ASSY	80489-3	25313	1
A125W2P1	SAME AS A124W1P1			
A125W3	CABLE AND PROBE ASSY	80021-1	25313	1
A125W3P1	SAME AS A124W1P1			
A125XV1	SAME AS W124XV1			
A125Z1	OSCILLATOR ASSY	80486	25313	1
A125Z2	PRESELECTOR ASSY	80484	25313	1
A126	TUNER,BAND 3	80041-3	25313	1
A126J1	SAME AS A121J1			
A126R1	SAME AS A124R1			
A126S1 AND S2	SAME AS A124S1			
A126V1	ELECTRON TUBE EMC PART NO. 30500-5721	5721	12094	1
A126W1	CABLE ASSY	80023-1	25313	1

TABLE 6-2. PARTS LIST, MODEL EMA-910-10 FREQUENCY SELECTION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A126W1P1	SAME AS W101P1			
A126W1P2	CONNECTOR,PLUG EMC PART NO. 30427-15975	15975	30684	1
A126W2	CABLE AND PROBE ASSY	80023-2	25313	1
A126W2P1	SAME AS W101P1			
A126W2P2	SAME AS A126W1P2			
A126W3	CABLE AND PROBE ASSY	80020-1	25313	1
A126W3P1	CONNECTOR,PLUG EMC PART NO. 30450-7	101-T1800	94375	1
A126XV1	SAME AS A124XV1			
A126Z1	OSCILLATOR ASSY	80212	25313	1
A126Z2	PRESELECTOR ASSY	80225	25313	1
A126Z2J1 AND J2	CONNECTOR,JACK	80027-2	25313	1
A127	TUNER,BAND 4	80041-4	25313	1
A127J1	SAME AS A121J1			
A127R1	SAME AS A124R1A			
A127S1 AND S2	SAME AS A124S1			
A127V1	ELECTRON TUBE EMC PART NO. 30500-2K48	2K48	13866	1
A127W1	CABLE ASSY	80023-3	25313	1
A127W1P1 AND P2	SAME AS W101P1			
A127W2	CABLE ASSY	80023-4	25313	1
A127W2P1 AND P2	SAME AS W101P1			
A127W3	CABLE AND PROBE ASSY	80013-1	25313	1
A127W3P1	SAME AS A126W3P1			
A127XV1	CONNECTOR,PLUG EMC PART NO. 30451-3	91MPF-31	02660	1
A127Z1	OSCILLATOR ASSY	80030	25313	1
A127Z2	PRESELECTOR ASSY	80006	25313	1
A127Z2J1 AND J2	CONNECTOR,JACK	80027-1	25313	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
CR201 THRU CR217	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-4003	1N4003	04173	3
C201 *	CAPACITOR,FIXED,CERAMIC DISC, 0.1UF,50V EMC PART NO. 30059-104	TGP10	80183	2
C202	CAPACITOR,FIXED,ELECTROLYTIC, 1UF,50V EMC PART NO. 30050-105	NLW1-50	09023	5
C203	CAPACITOR,FIXED,MYLAR, 0.22 UF,PORM 20 PCT 200V EMC PART NO. 30062-224	D2-224	99515	1
C205	CAPACITOR,FIXED,FEED-THRU, 0.001 UF GMV EMC PART NO. 30081-102	FB2B-102	01121	1
C206	CAPACITOR,FIXED,MYLAR, 0.022 UF,PORM 20 PCT 100V EMC PART NO. 30063-223	D1-223	99515	1
C207 AND C208	CAPACITOR,FIXED,FEED-THRU, 0.001 UF,GMV EMC PART NO. 30075-102	FASC-102	01121	1
C209	CAPACITOR,FIXED,PAPER, 0.047 UF,100V EMC PART NO. 30061-473	96P47291	80183	1
C212	CAPACITOR,FIXED,ELECTROLYTIC, 5UF,50V EMC PART NO. 30050-505	NLW5-50	09023	2
C213 THRU C216	SAME AS C207			
C218	CAPACITOR,FIXED,MYLAR, 0.82 UF,PORM 20 PCT, 100V EMC PART NO. 30063-824	D1-824	99515	1
C219	CAPACITOR,FIXED,MYLAR, 0.082 UF,PORM 20 PCT, 100V EMC PART NO. 30063-823	D1-823	99515	1
C220	CAPACITOR,FIXED,MYLAR, 0.018 UF,PORM 20 PCT, 100V EMC PART NO. 30063-183	D1-183	99515	1
C221	CAPACITOR,FIXED,MYLAR, 0.0018 UF,PORM 20PCT 100V EMC PART NO. 30063-182	D1-182	99515	1
C227	CAPACITOR,FIXED,CERAMIC DISC, 0.02 UF,100V	THS20	80183	3
C228	SAME AS C202			
C230	SAME AS C212			
C231 AND C232	SAME AS C202			
C233 THRU C238	CAPACITOR,FIXED,DIPPED MICA, 470 PF,PORM 5 PCT,500V EMC PART NO. 30078-471	DM15-471J	84171	1
C240 THRU C285	SAME AS C205			
C301 THRU C314	SAME AS C207			
C315	CAPACITOR,FIXED,ELECTROLYTIC, 20000 UF,35V EMC PART NO. 30071-203M	539-264501	53021	1
C316	CAPACITOR,FIXED,ELECTROLYTIC, 10000 UF,50V EMC PART NO. 30072-103M	539-2650-D1	53021	1
DS201 THRU DS204	LAMP,NEON EMC PART NO. 30510-NE51H	NE51H	71744	5

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
CS301	SAME AS CS201			
FL2C1	FILTER,BANDPASS, 240 MHZ CTR FREQ, 10 MHZ BW	80067-1	25313	1
FL2C1J1 AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF FL201			
FL2C2	FILTER,BANDPASS, 60 MHZ CTR FREQ, 5 MHZ BW	80068-1	25313	1
FL2C2J1 AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF FL202			
FL2C3	FILTER,BANDPASS, 60 MHZ CTR FREQ, 1 MHZ BW	80069-1	25313	1
FL2C3J1 AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF FL203			
FL2C4	FILTER,BANDPASS, 60 MHZ CTR FREQ,0.5 MHZ BW	80070-1	25313	1
FL2C4J1 AND J2	CONNECTOR,JACK,NON-REPLACEABLE PART OF FL204			
FL3C1 AND FL3C2	FILTER,LINE EMC PART NO. 30110	GF4100-9	86151	1
F301 AND F302	FUSE,DELAY, 5 AMPS EMC PART NO. 30700-0500	313005.	75915	4
F303 THRU F306	FUSE,DELAY, 0.75AMPS EMC PART NO. 30700-0075	313.750	75915	6
F307	FUSE,DELAY, 10 AMPS EMC PART NO. 30700-1000	313010.	75915	1
J201 THRU J216	CONNECTOR,JACK, 15 PIN EMC PART NO. 30428-15	VK15S/1-2	05574	1
J217	CONNECTOR,JACK, 55PIN EMC PART NO. 3044C-55	PC07A-22-55S	12143	1
J240	CONNECTOR,JACK, 22 PIN EMC PART NO. 30428-22	VK22S/1-2	05574	1
J241	CONNECTOR,JACK,50 PIN EMC PART NO. 30452-50	57-40500	02660	1
J242-1 AND J242-2	JACK,PIN EMC PART NO. 30643-2	SKT-22	98291	2
J242-4 THRU J242-8	SAME AS J242-1			
J249	CONNECTOR,JACK TNC EMC PART NO. 30450-1	101-T380075	94375	1
J250 THRU J253	CONNECTOR,JACK, BNC EMC PART NO. 30448-5354	5354	91737	1
J255 AND J256	JACK,PHONE EMC PART NO. 30444	C12A	82389	1
J257	SAME AS J250			
J258	CONNECTOR,JACK, 6 PIN EMC PART NO. 30457-6	91-PC6F	02660	1
J259-1 AND J259-2	SAME AS J242-1			
J259-4 THRU J259-8	SAME AS J242-1			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
J301	CONNECTOR,JACK, 3PIN EMC PART NO. 30468	5278	04009	1
K201 THRU K212	RELAY, 24V, 4PDT EMC PART NO. 30351	KHP17D-11	77342	2
K213	RELAY,THERMAL,TIME DELAY, 60 SECOND EMC PART NO. 30356	26N060T	70563	1
M201	METER,OUTPUT	30650-2	25313	1
P217	CONNECTOR,PLUG, 5 PIN EMC PART NO. 30437-5	126-226	02660	1
P218	CONNECTOR,PLUG, 15 PIN EMC PART NO.30461-15	DA-15S	71468	1
P219	CONNECTOR,JACK EMC PART NO. 30647-9	690003-1340	00373	1
P220	CONNECTOR,PLUG, 9 PIN EMC PART NO. 30461-9	DE9S	71468	1
P221	SAME AS P218			
P245	SAME AS P218			
P246	SAME AS P219			
P301	CONNECTOR,PLUG, 9 PIN EMC PART NO. 30459-9	MRA9S	81312	1
P302	CONNECTOR,PLUG, 20 PIN EMC PART NO. 30432-20	MRE20S	81312	1
R201	RESISTOR,VARIABLE,NON-REPLACEABLE PART OF S2			
R202	RESISTOR,FIXED,COMP., 27K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-273	EB2735	01121	3
R203	RESISTOR,FIXED,COMP., 18K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-183	EB1835	01121	1
R204	RESISTOR,FIXED,COMP., 1MEGOHM ,PORM 5 PCT, 1/2W EMC PART NO. 30001-105	EB1055	01121	3
R205 THRU R207	RESISTOR,VARIABLE, 5K OHMS,PORM 20 PCT,1/2W	30257-502	25313	1
R208	RESISTOR,FIXED,COMP., 10K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-103	EB1035	01121	5
R209 AND R210	RESISTOR,VARIABLE, 500 OHMS,PORM 20 PCT,1/2W	30257-501	25313	1
R211	RESISTOR,FIXED,COMP.,1200 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-122	EB1225	01121	1
R212	SAME AS R209			
R213	RESISTOR,FIXED,COMP., 470 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-471	EB4715	01121	2
R214	SAME AS R208			
R215	RESISTOR,VARIABLE, 100K OHMS, PORM 10 PCT, 1/2W EMC PART NO. 30258-104	75R100K	73138	1
R216	RESISTOR,TEMPERATURE SENSITIVE,PTC, 270 OHMS PORM 5 PCT,1/4W EMC PART NO. 30023-271	TM1/4-270OHMPORM5PCT	01295	1
R217	SAME AS R204			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
R218 THRU R220	SAME AS R208			
R221	SAME AS R204			
R222	RESISTOR,FIXED,FILM, 237 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-2370	RN65D2370F	79727	1
R223	RESISTOR,FIXED,COMP.,8200 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-822	EB8225	01121	1
R224	RESISTOR,VARIABLE, 10K OHM,2W	30255-103	25313	1
R226 THRU R228	SAME AS R205			
R229	RESISTOR,FIXED,COMP.,5600 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-562	EB5625	01121	1
R230	RESISTOR,VARIABLE,NON-REPLACEABLE PART OF S211			
R231	RESISTOR,FIXED,COMP.,3900 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-392	EB3925	01121	2
R232	RESISTOR,FIXED,FILM, 1000 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-1001	RN65D1001F	79727	3
R233	SAME AS R209			
R234	RESISTOR,VARIABLE, 10K OHM,PORM 1 PCT, 0.25 PCT LINEARITY EMC PART NO. 30253-103	7221-R10KL.25	73138	1
R235	SAME AS R209			
R236	SAME AS R234			
R237 AND R238	SAME AS R209			
R239	RESISTOR,FIXED,FILM, 470 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-4700	RN65D4700F	79727	1
R240	RESISTOR,FIXED,COMP.,4700 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-472	EB4725	01121	2
R241	SAME AS R204			
R242	SAME AS R229			
R243	RESISTOR,FIXED,COMP., 15K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-153	EB1535	01121	1
R244	SAME AS R239			
R245	SAME AS R232			
R246	RESISTOR,VARIABLE,NON-REPLACEABLE PART OF S212			
R248	SAME AS R204			
R249	SAME AS R202			
R250	RESISTOR,FIXED,COMP., 22 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-220	EB2205	01121	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
R251	RESISTOR,FIXED,COMP.,820K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-824	EB8245	01121	1
R252	RESISTOR,VARIABLE, 1K OHM,2W	30255-102	25313	1
R253	SAME AS R224			
R257	SAME AS R223			
R258	SAME AS R224			
R259	SAME AS R213			
R260	RESISTOR,VARIABLE, 10K OHMS,2W	30267-103	25313	1
R301 AND R302	SAME AS R240			
R303	RESISTOR,FIXED, WIRE WOUND, 2 OHMS,PORM 5 PCT,12W EMC PART NO. 30005-20A	1705	44655	1
S201	SWITCH,ROTARY, 2P4T	30285-1	25313	1
S202	SWITCH,ROTARY, 2P4T	30275-4	25313	1
S203	SWITCH,ROTARY, 2P5T	30275-5	25313	1
S204	SAME AS S202			
S205	SWITCH,ROTARY, 6P3T	30276-3	25313	1
S206	SWITCH,ROTARY, 3P3T	30280-3	25313	1
S207	SWITCH,ROTARY, 2P3T	30275-3	25313	1
S208	SAME AS S205			
S209 AND S210	SWITCH,PUSH BUTTON, SPST EMC PART NO. 30277	B7001	81640	1
S211	SWITCH,ROTARY, 2P2T	30281-202	25313	1
S212	SWITCH,ROTARY, 2P2T	30288-2	25313	1
S213	SAME AS S209			
S301 AND S302	SWITCH,ROTARY, DPDT EMC PART NO. 30278	51725	04009	1
TS301	TERMINAL STRIP, 8 TERMINALS EMC PART NO. 30438-8	8-140	71785	1
TS302	TERMINAL STRIP, 10 TERMINALS EMC PART NO. 30438-10	10-140	71785	1
T201	TRANSFORMER,AUDIO	80379-1	25313	1
T301	TRANSFORMER,POWER	30150	25313	1
T302	TRANSFORMER,POWER	30151	25313	1
W201	CABLE ASSY	80093-1	25313	1
W201P1 AND P2	CONNECTOR,PLUG EMC PART NO. 30450-6	101-B1600	94375	1
W202	CABLE ASSY	80093-2	25313	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
W202P1 AND P2	SAME AS W201P1			
W203	CABLE ASSY	80093-3	25313	1
W203P1 AND P2	SAME AS W201P1			
W204	CABLE ASSY	80093-4	25313	1
W204P1 AND P2	SAME AS W201P1			
W205	CABLE ASSY	80093-5	25313	1
W205P1 AND P2	SAME AS W201P1			
W206	CABLE ASSY	80093-6	25313	1
W206P1 AND P2	SAME AS W201P1			
W207	CABLE ASSY	80093-7	25313	1
W207P1 AND P2	SAME AS W201P1			
W208	CABLE ASSY	80096-1	25313	1
W208P1	SAME AS W201P1			
W208P2	CONNECTOR,PLUG EMC PART NO. 30450-3	101-B2800	94375	1
W209	CABLE ASSY	80093-8	25313	1
W209P1 AND P2	SAME AS W201P1			
W210	CABLE ASSY	80155-5	25313	1
W210P1 AND P2	SAME AS W208P2			
W211	CABLE ASSY	80155-6	25313	1
W211P1 AND P2	SAME AS W208P2			
W212	CABLE ASSY	80092-1	25313	1
W212P1	SAME AS W208P2			
W213	CABLE ASSY	80096-2	25313	1
W213P1	SAME AS W201P1			
W213P2	SAME AS W208P2			
W214	CABLE ASSY	80129-1	25313	1
W214P1	SAME AS W201P1			
W215	CABLE ASSY	80096-3	25313	1
W215P1	SAME AS W208P2			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
W215P2	SAME AS W201P1			
W216	CABLE ASSY	80093-9	25313	1
W216P1 AND P2	SAME AS W201P1			
W217	CABLE ASSY	80093-10	25313	1
W217P1 AND P2	SAME AS W201P1			
W218	CABLE ASSY	80096-4	25313	1
W218P1	SAME AS W201P1			
W218P2	SAME AS W208P2			
W219	CABLE ASSY	80093-11	25313	1
W219P1 AND P2	SAME AS W201P1			
W220	CABLE ASSY	80093-12	25313	1
W220P1 AND P2	SAME AS W201P1			
W221	CABLE ASSY	80093-13	25313	1
W221P1 AND P2	SAME AS W201P1			
W222	CABLE ASSY	80096-5	25313	1
W222P1	SAME AS W201P1			
W222P2	SAME AS W208P2			
W223	CABLE ASSY	80093-14	25313	1
W223P1 AND P2	SAME AS W201P1			
W224	CABLE ASSY	80093-14	25313	1
W224P1 AND P2	SAME AS W201P1			
W225	CABLE ASSY	80157-1	25313	1
W225P1	SAME AS W201P1			
W226	CABLE ASSY	80129-2	25313	1
W226P1	SAME AS W201P1			
W227	CABLE ASSY	80097-1	25313	1
W227P1	SAME AS W208P2			
W228	CABLE ASSY	80097-2	25313	1
W228P1	SAME AS W208P2			
W229	CABLE ASSY	80097-3	25313	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
W229P1	SAME AS W208P2			
W230	CABLE ASSY	80092-2	25313	1
W230P1	SAME AS W208P2			
W231	CABLE ASSY	80095-1	25313	1
XK213	SOCKET,RELAY, 9 PIN EMC PART NO. 30503	TS103P01	71785	1
Z201 AND Z202	RELAY,COAXIAL TRANSFER EMC PART NO. 30350-1	327-010582-3	02660	1
Z201J1 THRU J4	CONNECTOR,JACK,NON-REPLACEABLE PART OF Z201			
Z202J1 THRU J4	CONNECTOR,JACK,NON-REPLACEABLE PART OF Z202			
Z203 AND Z204	RELAY,COAXIAL,SINGELPOLE,4 SECTION	80386-1	25313	1
Z203J1 THRU J5	CONNECTOR,JACK,NON-REPLACEABLE PART ON Z203			
Z204J1 THRU J5	CONNECTOR,JACK,NON-REPLACEABLE PART OF Z204			
A201	AUDIO AMPLIFIER	80112-1	25313	1
A201CR1	SEMICONDUCTOR,DEVICE,DIODE EMC-PART NO. 30600-498	1N498	93332	1
A201C1 AND C2	SAME AS C227			
A201C3	CAPACITOR,FIXED,CERAMIC DISC, 0.005 UF,100V EMC PART NO. 30057-502	TH-D50	80183	1
A201C4	SAME AS C201			
A201C5 AND C6	SAME AS C202			
A201Q1 AND Q2	TRANSISTOR EMC PART NO.30550-3567	2N3567	07263	1
A201Q3 AND Q4	TRANSISTOR EMC PART NO. 30550-1481	2N1481	02735	1
A201R1	RESISTOR,FIXED,COMP., 47K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-473	EB4735	01121	2
A201R2	RESISTOR,FIXED,COMP., 100K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-104	EB1045	01121	2
A201R3	RESISTOR,FIXED,COMP., 100 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-101	EB1015	01121	3
A201R4 AND R5	SAME AS R208			
A201R6	RESISTOR,FIXED,COMP.,6800 OHMS,PORM 5 PCT 1/2W EMC PART NO. 30001-682	EB6825	01121	1
A201R7 AND R8	RESISTOR,FIXED,COMP., 1000 OHMS,PORM 5 PCT 1/2W EMC PART NO. 30001-102	EB1025	01121	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A201R9 AND R10	RESISTOR,FIXED,COMP., 2.7K OHMS,PORM 5 PCT 1/2W EMC PART NO. 30001-272	EB2725	01121	1
A201R11	SAME AS R240			
A201R12 AND R13	SAME AS R213			
A201R14	RESISTOR,FIXED,COMP., 4.7 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-47A	EB4R75	01121	1
A201R15	RESISTOR,FIXED,COMP., 330 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-331	EB3315	01121	1
A202	+12 / +24 VOLT REGULATOR	80100-1	25313	1
A202CR1	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30060-825	1N825	81483	1
A202C2 AND C3	CAPACITOR,FIXED,CERAMIC DISC, 100 PF,600V EMC PART NO. 30058-101	5GA-T10	80183	1
A202C5 AND C6	SAME AS C227			
A202Q1 THRU Q5	SAME AS A201Q1			
A202Q6	TRANSISTOR EMC PART NO. 30550-3565	2N3565	07263	2
A202R2	RESISTOR,FIXED,COMP.,1800 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-182	EB1825	01121	1
A202R3	RESISTOR,FIXED,FILM, 768 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-7680	RN65D7680F	79727	1
A202R4	RESISTOR,FIXED,FILM, 953 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-9530	RN65D9530F	79727	1
A202R5	RESISTOR,VARIABLE, 200 OHMS EMC PART NO. 30250-201	3067P-201	80294	1
A202R6 AND R7	SAME AS R232			
A202R8	SAME AS A202R5			
A202R9	SAME AS R208			
A202R10	SAME AS R232			
A202R12	SAME AS R208			
A202R13	SAME AS A201R7			
A203	-12 / -24 VOLT REGULATOR	80101-1	25313	1
A203C2 AND C3	SAME AS A202C2			
A203C5	SMAE AS C201			
A203C6	SAME AS C227			
A203Q1	TRANSISTOR EMC PART NO. 30550-3638	2N3638	07263	2
A203Q2	TRANSISTOR EMC PART NO. 30550-3638A	2N3638A	07263	2

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A203C3	SAME AS A203C1			
A203C4	SAME AS A203C2			
A203R2	SAME AS R208			
A203R3	RESISTOR,FIXED,COMP.,1500 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-152	EB1525	01121	1
A203R5	SAME AS R232			
A203R6	SAME AS A202R5			
A203R7 AND R8	SAME AS R232			
A203R9	SAME AS A202R5			
A203R10	SAME AS R232			
A203R11	SAME AS A201R7			
A204	+27 VOLT REGULATOR	80102-1	25313	1
A204CR1	SAME AS CR201			
A204C1 AND C2	SAME AS C227			
A204C1 THRU C3	SAME AS A203C1			
A204R1	SAME AS A201R3			
A204R2	SAME AS R208			
A204R3	SAME AS A201R9			
A204R4	SAME AS A201R1			
A204R5	SAME AS R208			
A204R6	RESISTOR,FIXED,FILM, 1300 OHMS,PORM1PCT 1/4W EMC PART NO. 30014-1301	RN65D1301F	79727	1
A204R7	SAME AS A202R5			
A204R8	SAME AS R232			
A204R13	SAME AS R232			
A205	SCHMITT TRIGGER	80108-1	25313	1
A205CR1	SAME AS CR201			
A205C1	CAPACITOR,FIXED,CERAMIC DISC, 270 PF,PORM 20 PCT,1CCOV EMC PART NO. 30058-271	5GAT27	80183	1
A205C2	CAPACITOR,FIXED,CERAMIC DISC, 0.001 UF,PORM 20 PCT,1CCOV EMC PART NO. 30058-102	5GAD10	80183	2
A205C4	SAME AS C201			
A205C5 AND C6	SAME AS C202			
A205C7	SAME AS A205C2			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A205C8	SAME AS A205C1			
A205Q1	TRANSISTOR EMC PART NO. 30550-4250	2N4250	07263	1
A205Q2 THRU Q5	SAME AS A203Q1			
A205R1	SAME AS R204			
A205R2	RESISTOR,FIXED,COMP.,4.7MEGOHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-475	EB4755	01121	1
A205R3	SAME AS A201R7			
A205R4	RESISTOR,FIXED,COMP., 39K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-393	EB3935	01121	1
A205R5	SAME AS R231			
A205R6	RESISTOR,FIXED,COMP., 33K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-333	EB3335	01121	2
A205R7	SAME AS R231			
A205R8	SAME AS A205R6			
A205R9 AND R10	SAME AS R208			
A205R11	SAME AS A205R6			
A205R12 AND R13	SAME AS A201R3			
A205R14	SAME AS R204			
A206	MULTIVIBRATOR / INTEGRATOR	80109-1	25313	1
A206CR1 THRU CR5	SAME AS CR201			
A206C1	SAME AS A202C2			
A206C2	SAME AS C206			
A206C3	SAME AS C227			
A206C4	CAPACITOR,FIXED,ELECTROLYTIC, 30 UF,50V EMC PART NO. 30050-300M	NLW-30-50	09023	1
A206C5	SAME AS C202			
A206Q1 THRU Q3	SAME AS A203Q1			
A206Q4	SAME AS A205Q1			
A206R1	RESISTOR,FIXED,COMP., 270 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-271	EB2715	01121	1
A206R2	RESISTOR,FIXED,COMP.,7500 OHMS,PORM 5 PCT 1/2W EMC PART NO. 30001-752	EB7525	01121	1
A206R3 AND R4	SAME AS R208			
A206R7	RESISTOR,FIXED,COMP., 750 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-751	EB7515	01121	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A206R8	SAME AS A201R1			
A206R9	SAME AS R208			
A206R10	SAME AS A201R3			
A206R12	RESISTOR,FIXED,COMP.,330K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-334	EB3345	01121	1
A206R13	SAME AS R208			
A206R14	SAME AS A201R3			
A206R15	SAME AS R202			
A207	FLOATING PLUS 28.5 / MINUS 28.5 VOLT REGULATOR	80114-1	25313	1
A207CR1	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-821	1N821	81483	1
A207C1 AND C2	SAME AS C227			
A207C3	CAPACITOR,FIXED,ELECTROLYTIC, 2 UF,50V EMC PART NO. 30050-205	NLW2-50	09023	1
A207C4 AND C5	CAPACITOR,FIXED,CERAMIC DISC, 0.003 UF,PORM 20 PCT,1000V EMC PART NO. 30058-203	5GAD30	80183	1
A207C6 AND C7	SAME AS A207C3			
A207Q1	SAME AS A201Q1			
A207Q2	SAME AS A203Q1			
A207Q3	SAME AS A201Q1			
A207Q4	SAME AS A203Q1			
A207Q5 AND Q6	SAME AS A201Q1			
A207Q7	SAME AS A203Q1			
A207R1	SAME AS R208			
A207R2 AND R3	SAME AS A201R3			
A207R4	SAME AS R208			
A207R5	SAME AS A201R7			
A207R6	RESISTOR,FIXED,COMP.,3300 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-332	EB3325	01121	2
A207R7 THRU R10	SAME AS A201R7			
A207R11	RESISTOR,FIXED,COMP., 680 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-681	EB6815	01121	1
A207R12	SAME AS R231			
A207R13	RESISTOR,FIXED,FILM, 7500 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-7501	RN65D7501F	79727	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A207R14	RESISTOR,VARIABLE,500 OHMS EMC PART NO. 30250-501	3067P-501	80294	1
A207R15	RESISTOR,FIXED,FILM, 1820 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-1821	RN65D1821F	79727	1
A207R16	RESISTOR,FIXED,FILM, 4750 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-4751	RN65D4751F	79727	1
A207R17	SAME AS A207R14			
A207R18	SAME AS A207R16			
A207R19	SAME AS R231			
A208	PEAK LEVEL VOLTAGE COMPARATOR	80103-1	25313	1
A208CR1	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-751	1N751	81483	1
A208Q1 THRU Q4	TRANSISTOR EMC PART NO. 30550-3369	2N3569	07263	1
A208Q5	SAME AS A203Q1			
A208Q6 AND Q7	SAME AS A208Q1			
A208R1 AND R2	SAME AS A201R7			
A208R3 AND R4	SAME AS R208			
A208R5	SAME AS R231			
A208R6 THRU R8	SAME AS R208			
A208R11 THRU R13	SAME AS R208			
A208R14	SAME AS A201R7			
A209	MEMORY CLEAR PULSE AMPLIFIER	80106-1	25313	1
A209CR1 THRU CR6	SAME AS CR201			
A209C1 AND C2	SAME AS C202			
A209Q1	SAME AS A202Q6			
A209Q2	SAME AS A208Q1			
A209Q3	SAME AS A203Q2			
A209R1 AND R2	SAME AS A201R3			
A209R3 AND R4	SAME AS R203			
A209R5	RESISTOR,FIXED,COMP., 22K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-223	EB2235	01121	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A209R7	SAME AS A209R5			
A209R8	SAME AS A201R7			
A209R9 AND R10	SAME AS R208			
A209R11	SAME AS A201R7			
A209R12 AND R13	SAME AS R231			
A209R14	SAME AS A201R7			
A210	SLICEBACK / VIDEO STRETCH AMPLIFIER	80105-1	25313	1
A210CR1 AND CR2	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-916	1N916	07263	1
A210C1	CAPACITOR,FIXED,MYLAR,0.1 UF,PORM 10 PCT, 200V EMC PART NO. 30062-104	D2-104	99515	1
A210C2	CAPACITOR,FIXED,DIPPED MICA, 820 PF,PORM 5 PCT,500V EMC PART NO. 30078-821	DM15-821J	84171	1
A210C3	CAPACITOR,FIXED,MYLAR, 0.0047 UF,PORM 10 PCT 100V EMC PART NO. 30063-472	D1-472	99515	1
A210C4	SAME AS A207C3			
A210C5	CAPACITOR,FIXED,ELECTROLYTIC, 220 UF,PORM 10 PCT,10V EMC PART NO. 30060-221M-10	K220C10K	05397	1
A210C6	SAME AS A207C3			
A210Q1 AND Q2	SAME AS A202Q6			
A210Q3	SAME AS A203Q2			
A210Q4	SAME AS A202Q6			
A210Q5	TRANSISTOR EMC PART NO. 30550-40327	40327	02735	1
A210Q6	SAME AS A202Q6			
A210Q7	SAME AS A201Q1			
A210Q8	SAME AS A202Q6			
A210R1 AND R2	SAME AS A201R7			
A210R3	SAME AS A201R2			
A210R4	RESISTOR,FIXED,COMP., 10 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-100	EB1005	01121	2
A210R5	SAME AS A207R6			
A210R6	SAME AS A201R2			
A210R7	SAME AS A210R4			
A210R8	SAME AS R231			
A210R9	SAME AS A210R4			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A210R10	SAME AS A208			
A210R11	SAME AS R204			
A210R12	SAME AS A202R2			
A210R13	SAME AS R202			
A210R14	SAME AS A202R2			
A210R15	RESISTOR,FIXED,COMP., 82K OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-823	EB8235	01121	1
A210R16	SAME AS R202			
A210R17	RESISTOR,FIXED,COMP., 47 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-470	EB4705	01121	1
A210R18 AND R19	SAME AS R208			
A211	AFC BIPOLAR PULSE STRETCHER	80110-1	25313	1
A211CR1 AND CR2	SAME AS A201CR1			
A211CR4 THRU CR11	SAME AS CR201			
A211C1 AND C2	SAME AS C201			
A211Q1	SAME AS A208Q1			
A211Q2	SAME AS A203Q2			
A211Q3 AND Q4	SAME AS A202Q6			
A211Q5 AND Q6	SAME AS A203Q2			
A211R1 AND R2	SAME AS R208			
A211R3 AND R4	SAME AS R240			
A211R5 AND R6	SAME AS A206R1			
A212	SCAN DIRECTION CONTROL FLIP-FLOP	80104-1	25313	1
A212CR1	SAME AS CR201			
A212CR2 AND CR3	SAME AS A201CR1			
A212CR4 THRU CR7	SAME AS CR201			
A212C1	SAME AS C201			
A212C3 AND C4	SAME AS C227			
A212C6	SAME AS C201			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A212C7 AND C8	CAPACITOR,FIXED,CERAMIC DISC, 220 PF,PORM 20 PCT,1000V EMC PART NO. 30058-221	5GAT22	80183	1
A212Q1 THRU Q3	SAME AS A201Q1			
A212R1	SAME AS R208			
A212R2	SAME AS R202			
A212R3	RESISTOR,FIXED,COMP.,2200 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-222	EB2225	01121	2
A212R4	SAME AS R229			
A212R5 AND R6	SAME AS R202			
A212R7	SAME AS R229			
A212R8	SAME AS A212R3			
A212R11				
A212C11	SAME AS R202			
A212R12 AND R13	SAME AS R208			
A212R14	SAME AS A207R6			
A213	SIGNAL PRESENT VOLTAGE COMPARATOR SEE A208 LIST FOR COMPONENTS		25313	1
A214	CROSSOVER VOLTAGE COMPARATOR SEE A208 LIST FOR COMPONENTS		25313	1
A215	LOW FREQUENCY ANALOG VOLTAGE COMPARATOR SEE A208 LIST FOR COMPONENTS		25313	1
A216	HIGH FREQUENCY ANALOG VOLTAGE COMPARATOR SEE A208 LIS FOR COMPONETS		25313	1
A217	PEAK OPERATIONAL AMPLIFIER EMC PART NO. 80241-1	A004A	07263	1
A218 AND A219	OPERATIONAL AMPLIFIER EMC PART NO. 80239-SQ10	SQ10	17276	1
A220	60-MHZ LINEAR I-F AMPLIFIER	80062-1	25313	1
A220CR1 THRU CR4	SAME AS A210CR1			
A220C2 AND C3	SAME AS A205C2			
A220C4	CAPACITOR,FIXED,DIPPED MICA, 12 PF,PORM 5, PCT,500V EMC PART NO. 30078-120	DM15-120J	84171	1
A220C5 THRU C7	SAME AS A205C2			
A220C8	SAME AS C233			
A220C9 AND C10	SAME AS A205C2			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A220C11	SAME AS C227			
A220C12	SAME AS C201			
A220C13 AND C14	SAME AS C227			
A220C15	SAME AS C233			
A220C17	SAME AS C227			
A220C18	CAPACITOR,FIXED,DIPPED MICA, 18 PF,PORM 5 PCT,500V EMC PART NO. 30078-180	DMI5-180J	84171	1
A220C19	CAPACITOR,VARIABLE, 0.8 TO 12 PF EMC PART NO. 30079	VC22GY	73899	1
A220C20	CAPACITOR,FIXED,DIPPED MICA, 43 PF,PORM 5 PCT,500V EMC PART NO. 30078-430	DMI5-430J	84171	1
A220C21	SAME AS A220C19			
A220C22 AND C23	SAME AS C233			
A220C24	SAME AS A205C2			
A220C25	CAPACITOR,FIXED,DIPPED MICA, 20 PF,PORM 5 PCT,500V EMC PART NO. 30078-200	DMI5-200J	84171	1
A220C26	SAME AS A220C19			
A220C27	SAME AS A205C2			
A220C28	CAPACITOR,FIXED,DIPPED MICA, 10 PF,PORM 5, PCT,500V EMC PART NO. 30078-100	DMI5-100J	84171	2
A220C29	CAPACITOR,FIXED,DIPPED MICA, 5 PF,PORM 5 PCT,500V EMC PART NO. 30078-50A	DMI5-050J	84171	1
A220C30	CAPACITOR,FIXED,DIPPED MICA, 22 PF,PORM 5 PCT,500V EMC PART NO. 30078-220	DM10-220J	84171	1
A220C31	CAPACITOR,FIXED,DIPPED MICA,33 PF,PORM 5 PCT,500V EMC PART NO. 30078-330	DM10-330J	84171	1
A220C32	SAME AS A220C20			
A220C33 THRU C37	SAME AS A205C2			
A220C38	SAME AS C227			
A220C39	SAME AS A205C2			
A220C40	SAME AS A220C4			
A220J1 AND J2	CONNECTOR,JACK EMC PART NO. 30426-928	UG928/U	02660	1
A220J3	CONNECTOR,JACK, 15 PIN EMC PART NO.30462-15	DA15P	71468	1
A220L1	COIL,R.F., 60 MHZ	80272-11	25313	1
A220L2	CHOKE,R.F., 2.7 UH EMC PART NO. 30102-27A	1840-16	99800	1
A220L3	SAME AS A220L1			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A220L4	SAME AS A220L2			
A220L5	SAME AS A220L1			
A220L6	COIL,R.F., 60 MHZ	80272-14	25313	1
A220L7	COIL,R.F., 60 MHZ	80272-2	25313	1
A220L8 AND L9	SAME AS A220L2			
A220L10	CHOKE,R.F., 4.7 UH EMC PART NO. 30101-47A	1537-28	99800	1
A220L11	SAME AS A220L2			
A220L12	COIL,R.F. 60 MHZ	80272-10	25313	1
A220L13	COIL,R.F., 60 MHZ	80272-2	25313	1
A220MC1	INTERATED CIRCUIT EMC PART NO. 30560-1050G	MC1550G	04713	1
A220Q1 AND Q2	TRANSISTOR EMC PART NO. 30550-3563	2N3563	07263	1
A220Q3	TRANSISTOR EMC PART NO. 30550-2217	2N2217	04713	1
A220R2	RESISTOR,FIXED,COMP.,2400 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-242	CB2425	01121	1
A220R3	RESISTOR,FIXED,COMP.,2000 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-202	CB2025	01121	2
A220R4	RESISTOR,FIXED,COMP., 330 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-331	CB3315	01121	1
A220R5	RESISTOR,FIXED,COMP., 820 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-821	CB8215	01121	1
A220R6	RESISTOR,FIXED,COMP., 510 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-511	CB5115	01121	2
A220R7	RESISTOR,FIXED,COMP., 33K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-333	CB3335	01121	1
A220R8	RESISTOR,FIXED,COMP., 8200 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-822	CB8225	01121	1
A220R9	RESISTOR,FIXED,COMP., 47K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-473	CB4735	01121	1
A220R10	RESISTOR,FIXED,COMP., 27K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-273	CB2735	01121	1
A220R11 AND R12	RESISTOR,FIXED,COMP.,1000 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-102	CB1025	01121	3
A220R13	RESISTOR,FIXED,COMP., 100 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-101	CB1015	01121	3
A220R14	RESISTOR,FIXED,COMP., 180 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-181	CB1815	01121	3
A220R15	SAME AS A220R3			
A220R16	RESISTOR,FIXED,COMP., 240 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-241	CB2415	01121	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A220R17	SAME AS A220R3			
A220R18	SAME AS A220R14			
A220R19	RESISTOR,FIXED,COMP.,5600 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-562	CB5625	01121	1
A220R20 AND R21	RESISTOR,FIXED,COMP., 3.3 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-33A	CB3R35	01121	2
A220R22	RESISTOR,FIXED,COMP., 680 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-681	CB6815	01121	2
A220R23	SAME AS A220R11			
A220R24	SAME AS A220R10			
A220R25	RESISTOR,FIXED,COMP., 560 OHMS,PORM 5 PCT, 1/4W EMC PART N/. 30009-561	CB5615	01121	1
A221	60-MHZ LOGARITHMIC I-F AMPLIFIER	80060-1	25313	1
A221CR1 THRU CR6	SAME AS A210CR1			
A221CR7 ANDC R8	SAME AS CR201			
A221C4 AND C5	SAME AS C233			
A221C6	CAPACITOR,FIXED,DIPPED MICA, 47 PF,PORM 5 PCT,500V EMC PART NO. 30078-470	DM15-470J	84171	1
A221C7	SAME AS C233			
A221C8 AND C9	SAME AS A220C28			
A221C10 AND C11	SAME AS C233			
A221C12	SAME AS A221C6			
A221C13	SAME AS A220C28			
A221C14	SAME AS A220C25			
A221C15 AND C16	SAME AS C233			
A221C17	SAME AS A221C6			
A221C18	SAME AS A220C28			
A221C19	SAME AS A220C25			
A221C20 AND C21	SAME AS C233			
A221C22	SAME AS A221C6			
A221C23	SAME AS A220C28			
A221C24	SAME AS A220C25			
A221C25 AND C26	SAME AS A233			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A221C27	SAME AS A221C6			
A221C28	SAME AS A220C28			
A221C29	SAME AS A220C25			
A221C30	SAME AS A220C28			
A221C31 AND C32	SAME AS C233			
A221C34	SAME AS A220C28			
A221C40	CAPACITOR,FIXED,DIPPED MICA, 330 PF, PORM 5 PCT,500V EMC PART NO. 30078-331	DM15-331J	84171	1
A221C41 AND C42	SAME AS A210C2			
A221C45 THRU C50	SAME AS A220C19			
A221C51	SAME AS C233			
A221C52 AND C53	SAME AS C227			
A221C54	SAME AS A220C19			
A221C55	SAME AS C233			
A221C56	SAME AS A221C6			
A221C57	SAME AS A221C40			
A221C58	SAME AS C233			
A221C59	SAME AS A210C2			
A221J1 AND J2	SAME AS A220J1			
A221J3	SAME AS A220J3			
A221J4 THRU J6	SAME AS A220J1			
A221L3	SAME AS A220L2			
A221L4	COIL,R.F., 60 MHZ	80272-16	25313	1
A221L5	CHOKE,R.F., 5.6 UH EMC PART NO. 30102-56A	1840-24	99800	1
A221L6	SAME AS A221L4			
A221L7	SAME AS A220L2			
A221L8	SAME AS A221L5			
A221L9	SAME AS A221L4			
A221L10	SAME AS A220L2			
A221L11	SAME AS A221L5			
A221L12	SAME AS A221L4			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A221L13	SAME AS A220L2			
A221L14	SAME AS A221L5			
A221L15	SAME AS A221L4			
A221L16	SAME AS A220L2			
A221L17	SAME AS A221L5			
A221L18	SAME AS A221L4			
A221L19 AND L20	SAME AS A220L2			
A221L21	COIL,R.F., 60 MHZ	80272-21	25313	1
A221MC1	AMPLIFIER,OPERATIONAL,MICROCIRCUIT EMC PART NO. 30560-C	UA702C	07263	1
A221Q1 THRU Q6	SAME AS A220Q2			
A221Q7	TRANSISTOR EMC PART NO. 30550-697	2N697	04713	1
A221Q8	SAME AS A203Q1			
A221Q9	TRANSISTOR, EMC PART NO. 30550-A490	A490	73445	1
A221RT1	THERMISTOR,1K EMC PART NO. 30225	KA31L1	15801	1
A221R1	RESISTOR,FIXED,COMP., 75 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-750	CB7505	01121	2
A221R2	RESISTOR,FIXED,COMP.,6800 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-682	CB6825	01121	3
A221R3	RESISTOR,FIXED,COMP.,5100 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-512	CB5125	01121	2
A221R4	SAME AS A221R1			
A221R5	SAME AS A220R22			
A221R6	RESISTOR,FIXED,COMP., 390 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-391	CB3915	01121	3
A221R7	SAME AS A220R6			
A221R8	RESISTOR,VARIABLE, 5K OHMS EMC PART NO. 30268-502	62R502	73138	1
A221R9	SAME AS A221R2			
A221R10	SAME AS A221R3			
A221R11	SAME AS A221R1			
A221R12	SAME AS A220R22			
A221R13	SAME AS A221R6			
A221R14	SAME AS A221R8			
A221R15	SAME AS A221R2			
A221R16	SAME AS A221R3			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A221R17	SAME AS A221R1			
A221R18	SAME AS A220R22			
A221R19	SAME AS A221R6			
A221R20	SAME AS A221R8			
A221R21	SAME AS A221R2			
A221R22	SAME AS A221R3			
A221R23	SAME AS A221R1			
A221R24	SAME AS A220R22			
A221R25	SAME AS A220R4			
A221R26	SAME AS A221R8			
A221R27	SAME AS A221R2			
A221R28	SAME AS A221R3			
A221R29	SAME AS A221R1			
A221R30	RESISTOR,FIXED,COMP., 750 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-751	CB7515	01121	1
A221R31	SAME AS A221R6			
A221R32	SAME AS A221R8			
A221R33	SAME AS A221R2			
R221R34	SAME AS A221R3			
A221R35	SAME AS A221R1			
A221R36	SAME AS A220R5			
A221R37	SAME AS A221R6			
A221R39	SAME AS A221R8			
A221R40	SAME AS A220R13			
A221R41	SAME AS A221R30			
A221R47	SAME AS A220R13			
A221R50	RESISTOR,FIXED,COMP., 51 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-510	CB5105	01121	3
A221R51	RESISTOR,FIXED,COMP.,2700 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-272	CB2725	01121	3
A221R52	SAME AS A220R11			
A221R53 AND R54	RESISTOR,FIXED,COMP., 5.1 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-51A	CB5R15	01121	1
A221R55	SAME AS A221R51			
A221R56 AND R57	SAME AS A221R50			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A221R58	SAME AS A220R8			
A221R59	RESISTOR,FIXED,COMP.,1500 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-152	CB1525	01121	1
A221R60	SAME AS A220R13			
A221R61	RESISTOR,FIXED,COMP., 910 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-911	CB9115	01121	1
A221R62	SAME AS A221R59			
A221R66	SAME AS A221R1			
A221R67	RESISTOR,FIXED,COMP., 200 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-201	CB2015	01121	1
A221R68	SAME AS A220R13			
A221R69 THRU R71	SAME AS A220R20			
A221R72	SAME AS A220R3			
A221R73	SAME AS A221R6			
A221R74	RESISTOR,FIXED,COMP., 18 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-180	CB1805	01121	1
A221R75	RESISTOR,FIXED,COMP., 10K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-103	CB1035	01121	3
A221R76	RESISTOR,FIXED,COMP., 300 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-301	CB3015	01121	1
A221R77	SAME AS A220R3			
A222	60-MHZ I-F AMPLIFIER / AFC DISCRIMINATOR	80061-1	25313	1
A222CR1 THRU CR4	SAME AS A210CR1			
A222CR5 THRU CR8	SAME AS CR201			
A222C1 AND C2	SAME AS C233			
A222C3	CAPACITOR,FIXED,DIPPED MICA, 36 PF,PORM 5 PCT,500V EMC PART NO. 30078-360	DM15-360J	84171	1
A222C4	SAME AS C227			
A222C5	SAME AS A220C28			
A222C6	SAME AS C233			
A222C7	SAME AS A221C6			
A222C8	SAME AS C227			
A222C9	SAME AS A220C28			
A222C10	SAME AS C233			
A222C11	CAPACITOR,FIXED,DIPPED MICA, 15 PF,PORM 5 PCT,500V EMC PART NO. 30078-150	DM15-150J	84171	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A222C12	SAME AS C227			
A222C13	SAME AS A222C11			
A222C14 AND C15	SAME AS C233			
A222C16	SAME AS A210C2			
A222C20	CAPACITOR,FIXED,DIPPED MICA, 100 PF,PERM 5 PCT,500V EMC PART NO. 30078-101	DM15-101J	84171	1
A222C21	SAME AS A221C40			
A222C22	CAPACITOR,FIXED,CERAMIC DISC, 4.7 PF,PERM C.25 PF,1000V EMC PART NO. 30076-47A	10TCC-V47	80183	1
A222C23 AND C24	SAME AS C227			
A222C27 AND C28	SAME AS A220C19			
A222C30	SAME AS A220C19			
A222C31	SAME AS C233			
A222C34	SAME AS A210C2			
A222C35	SAME AS C227			
A222C36 AND C37	SAME AS A220C19			
A222J1 THRU J3	SAME AS A220J1			
A222J4	SAME AS A220J3			
A222L1	COIL,R.F. 60 MHZ	80272-7	25313	1
A222L2	SAME AS A220L2			
A222L3	COIL,R.F., 60 MHZ	80272-8	25313	1
A222L4	SAME AS A220L2			
A222L5	SAME AS A220L13			
A222L6 AND L7	SAME AS A220L2			
A222L9	COIL,R.F., 63 MHZ	80289-6	25313	1
A222L10	COIL,R.F., 57 MHZ	80289-8	25313	1
A222MC1	SAME AS A221MC1			
A222Q1 THRU Q3	SAME AS A220Q1			
A222Q4	SAME AS A201Q1			
A222Q5 AND Q6	SAME AS A203Q1			
A222RT1	SAME AS A221RT1			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A222R2	SAME AS A221R2			
A222R3	SAME AS A221R75			
A222R4	RESISTOR,FIXED,COMP., 2.7 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-27A	CB2R75	01121	1
A222R5	SAME AS A220R11			
A222R6	RESISTOR,FIXED,COMP.,120K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-124	CB1245	01121	1
A222R7	RESISTOR,FIXED,COMP., 470 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-471	CB4715	01121	1
A222R8	SAME AS A221R2			
A222R9	SAME AS A221R75			
A222R10	SAME AS A221R53			
A221R11	SAME AS A220R11			
A222R12	SAME AS A221R2			
A222R13	SAME AS A221R75			
A222R14	SAME AS A222R4			
A222R15	SAME AS A220R11			
A222R16	SAME AS A221R6			
A222R17	SAME AS A220R20			
A222R19	SAME AS A220R11			
A222R21 AND R22	SAME AS A220R11			
A222R23	SAME AS A221R61			
A222R24	SAME AS A221R50			
A222R25	SAME AS A221R51			
A222R26	SAME AS A220R20			
A222R27	SAME AS A220R11			
A222R28	RESISTOR,FIXED,COMP., 10 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-100	CB1005	01121	3
A222R29	SAME AS A221R50			
A222R30	SAME AS A222R28			
A222R31	SAME AS A221R51			
A222R32	SAME AS A221R50			
A222R35	SAME AS A220R20			
A222R36	SAME AS A221R67			
A222R38	SAME AS A220R9			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A222R39 AND R40	SAME AS A222R28			
A222R41	RESISTOR,FIXED,COMP., 20K OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-203	CB2035	01121	1
A222R42	SAME AS A220R9			
A222R43	SAME AS A221R76			
A222R44	SAME AS A221R6			
A222R45 AND R46	SAME AS A220R11			
A222R47	SAME AS A220R6			
A222R48	RESISTOR,VARIABLE, 2K OHMS EMC PART NO. 30250-202	3067P-202	80294	1
A222R49	SAME AS A220R13			
A222R50	RESISTOR,FIXED,COMP.,2.2MEGOHM,PORM 5 PCT, 1/4W EMC PART NO. 30009-225	CB2255	01121	1
A222R51	SAME AS A221R50			
A223	VIDEO BUFFER / PEAK DRIVER AMPLIFIER	80071-1	25313	1
A223CR1 AND CR2	SAME AS CR201			
A223CR3	SAME AS A208CR1			
A223CR4	SAME AS CR201			
A223CR5 AND CR6	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-3595	2N3595	07263	1
A223CR7 AND CR8	SAME AS CR201			
A223C1	SAME AS C202			
A223C2	SAME AS C227			
A223C3	SAME AS C201			
A223C4	CAPACITOR,FIXED,DIPPED MICA, 1000 PF,PORM 5 PCT,500V EMC PART NO. 30078-102	DM19-102J	84171	1
A223C5	SAME AS C202			
A223C7	SAME AS C202			
A223C8	CAPACITOR,FIXED,ELECTROLYTIC, 10 UF,PORM 10 PCT,20V EMC PART NO. 30060-100M-20	K10C20K	05397	1
A223J1	CONNECTOR,JACK, 9 PIN EMC PART NO. 30462-9	DE9P	71468	1
A223J2 AND J3	CONNECTOR,JACK EMC.PART NO. 30426-625	UG625/U	02660	1
A223Q1	SAME AS A208Q1			
A223Q2	SAME AS A203Q2			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A223C3	SAME AS A208C1			
A223C4 AND C5	SAME AS A202C6			
A223C6	SAME AS A203C2			
A223C7	SAME AS A208C1			
A223C8	SAME AS A202C6			
A223R1	SAME AS A221R51			
A223R2	SAME AS A222R28			
A223R3	SAME AS A220R13			
A223R4 AND R5	SAME AS A222R28			
A223R6	SAME AS A221R51			
A223R7	SAME AS A222R28			
A223R8	RESISTOR,FIXED,COMP.,1800 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-182	CB1825	01121	3
A223R9	SAME AS A220R14			
A223R10	RESISTOR,FIXED,COMP., 9.1 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-91A	CB9R15	01121	1
A223R11	RESISTOR,FIXED,COMP., 1MEGOHMS, PORM 5 PCT, 1/4W EMC PART NO. 30009-105	CB1055	01121	1
A223R12 AND R13	SAME AS A221R75			
A223R14	RESISTOR,FIXED,COMP.,4700 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-472	CB4725	01121	1
A223R15 AND R16	SAME AS A221R2			
A223R17	SAME AS A222R28			
A223R18	SAME AS A220R13			
A223R19	SAME AS A220R8			
A223R20	SAME AS A220 R11			
A223R21	SAME AS A222R7			
A223R23	SAME AS A220R11			
A223R24 AND R25	SAME AS A221R75			
A223R26	RESISTOR,FIXED,COMP.,12MEGOHM ,PORM 5 PCT 1/4W EMC PART NO. 30009-126	CB1265	01121	1
A223R27	SAME AS A220R14			
A223TP1	SAME AS J242-1			
A224	I-F ATTENUATOR / SIGNAL SAMPLER	80417-1	25313	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A224C1	SAME AS A222C22			
A224C2	CAPACITOR,FIXED,CERAMIC DISC, 1 PF,PORM 0.25 PF,100OV EMC PART NO. 3C076-10A	10TCC-U10	80183	1
A224J1 THRU J10	SAME AS A223J2			
A224R1	RESISTOR,FIXED,COMP., 39 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 3C001-390	EB3905	01121	2
A224R2	RESISTOR,VARIABLE,100 OHMS,1/2W EMC PART NO. 30254-101	AS3601	44655	1
A224R3	SAME AS A224R1			
A224R4	RESISTOR,FIXED,COMP., 18 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 3C001-180	EB1805	01121	1
A224R5	SAME AS A224R1			
A224R6	SAME AS A224R2			
A224R7	SAME AS A224R1			
A224R8	RESISTOR,FIXED,COMP., 9.1 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 3C001-91A	EB9R15	01121	1
A224R9 AND R10	RESISTOR,FIXED,COMP., 51 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 3C001-510	EB5105	01121	1
A225	240 / 60-MHZ MIXER	80375-1	25313	1
A225CR1	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30599-2350	HPA2350	28480	1
A225C1	CAPACITOR,FIXED,CERAMIC DISC, 8.2 PF,PORM 5 PCT,100OV EMC PART NO. 3C076-82A	10TCC-V82	80183	1
A225C2	CAPACITOR,FIXED,CERAMIC DISC, 6.8 PF,PORM 5 PCT,100OV EMC PART NO. 30076-68A	10TCC-V68	80183	1
A225C3	SAME AS A225C1			
A225C4	SAME AS A224C2			
A225C6 AND C7	SAME AS A221C6			
A225C8 AND C9	SAME AS A205C2			
A225C10	CAPACITOR,FIXED,CERAMIC DISC, 27 PF,PORM 5 PCT,100OV EMC PART NO. 3C076-270	10TCC-Q27	80183	1
A225C11 THRU C13	SAME AS A205C2			
A225C14	SAME AS A220C28			
A225J1 THRU J3	SAME AS A223J2			
A225J4	CONNECTOR,JACK EMC PART NO. 30639	FTSM-19	98291	1
A225L1 AND L2	SAME AS A220L7			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A225L3	COIL,R.F., 180 MHZ	80290-9	25313	1
A225L4	COIL,R.F.	80272-5	25313	1
A225L5 AND L6	COIL,R.F.	80272-6	25313	1
A225L7	COIL,R.F., 60 MHZ	80370-18	25313	1
A225Q1	SAME AS A220Q1			
A225R1	RESISTOR,FIXED,COMP.,3900 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-392	CB3925	01121	1
A225R2	SAME AS A222R7			
A225R3	RESISTOR,FIXED,COMP., 12K OHMS,PORM 5 PCT 1/4W EMC PART NO. 30009-U23	CB1235	01121	1
A225R4	SAME AS A220R13			
A225R5	SAME AS A221R50			
A225R6	SAME AS A221R1			
A226	CRYSTAL-CONTROLLED OSCILLATOR	80144-1	25313	1
A226C1	CAPACITOR,FIXED,STANDOFF, 0.001 UF,GMV EMC PART NO 30074-102	SS5C-102	01121	1
A226C2	SAME AS C207			
A226C3	SAME AS A220C31			
A226C4	SAME AS A220C28			
A226C5	SAME AS A220C31			
A226C6 ANF C7	SAME AS C207			
A226C8	CAPACITOR,FIXED,CERAMIC DISC, 3.3 PF,PORM 0.25 PF,1000V EMC PART NO. 30076-33A	10TCC-V33	80183	1
A226C9	SAME AS A220C31			
A226C10	CAPACITOR,FIXED,CERAMIC DISC, 330 PF,PORM 20 PCT,1000V EMC PART NO. 30058-331	5GAT33	80183	1
A226C11	SAME AS C233			
A226C12	SAME AS A224C2			
A226J1	CONNECTOR,JACK EMC PART NO. 30476-625	UG625/1	02660	1
A226J2	CONNECTOR,JACK,.5 PIN EMC PACT NO. 30436-5	126-216	02660	1
A226L1 AND L2	COIL,R.F., 0.33 UH EMC PART N3. 30101-33B	1537-04	99800	1
A226L3	COIL,R.F., 90 MHZ	80289-6-500	25313	1
A226L4	COIL,R.F., 180 MHZ	80289-4-0350	25313	1
A226L5	COIL,R.F., 180 MHZ	80290-9	25313	1
A226Q1 AND Q2	SAME AS A220Q2			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A226R1	SAME AS A221R51			
A226R2	SAME AS A221R59			
A226R3	SAME AS A220R14			
A226R4	RESISTOR,FIXED,COMP.,2200 OHMS,PORM 5 PCT 1/4W EMC PART NO. 30009-222	CB2225	01121	1
A226R5	SAME AS A220R13			
A226R6	SAME AS A221R51			
A226Y1	CRYSTAL,QUARTZ 90.000 MHZ EMC PART NO. 30640	CR56/U	74306	1
A228	400-HZ AND HIGH VOLTAGE POWER SUPPLY	80141-1	25313	1
A228BR1	BRIDGE,FULL WAVE, 3000P1V EMC PART NO. 30600-BR3	SCBR30A	14099	1
A228BR2	BRIDGE,FULL WAVE, 2000P1V EMC PART NO. 30600-BR2	SCBR20A	14099	1
A228CR1	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30550-609	1M609	01295	1
A228C1 AND C2	CAPACITOR,FIXED,ELECTROLYTIC, 10 UF,25V EMC PART NO. 30055-10CM	NLW10-25	09023	1
A228C4	CAPACITOR,FIXED,ELECTROLYTIC, 500 UF,50V EMC PART NO. 30095-501M	BR500-50	09023	1
A228C6	CAPACITOR,FIXED,CERAMIC DISC, 0.005 UF,2000V EMC PART NO. 30068-502	BLD50	80183	1
A228C7 THRU C12	CAPACITOR,FIXED,ELECTROLYTIC, 4 UF,600V EMC PART NO. 30054-405	PRS1845	00656	1
A228C13 THRU C16	CAPACITOR,FIXED,ELECTROLYTIC, 8 UF,500V EMC PART NO. 30053-805	PRS1805	00656	1
A228C17	CAPACITOR,FIXED,CERAMIC DISC, 0.02 UF,PORM 2 PCT,1000V EMC PART NO. 30070-203	5GAS20	80183	1
A228J1	CONNECTOR,JACK, 9 PIN EMC PART NO. 30472-9	126-221	02660	1
A228L1 THRU L3	CHOKE,ENCAPSULATED, 200 MH	30100	25313	1
A228R1 THRU R3	RESISTOR,FIXED,WIRED, 10 OHMS5W EMC PART NO. 30007-100	453E-1005	80183	1
A228R4 AND R5	RESISTOR,FIXED,WIREWOUND, 4 OHMS,5W EMC PART NO. 30007-4CA	453E-4R05	80183	1
A228R6	RESISTOR,FIXED,COMP., 2700 OHMS,PORM 10 PCT, 1W EMC PART NO. 30002-272	GB2721	01121	1
A228R7	RESISTOR,FIXED,WIREWOUND, 2200 OHMS,PORM 5 PCT,3W EMC PART NO. 30006-10B	SA31	14193	1
A228R10 THRU R15	RESISTOR,FIXED,COMP., 1MEGOHM,PORM 10 PCT,2W EMC PART NO. 30003-105	HB1051	01121	1
A228R16 THRU R19	RESISTOR,FIXED,COMP., 1 MEGOHM,PORM 10 PCT, 1W EMC PART NO. 30002-105	GB1051	01121	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A228R20 AND R21	RESISTOR,FIXED,COMP., 270 OHMS,PORM 10 PCT, 2W EMC PART NO. 30003-271	HB2711	01121	1
A228TS1 AND TS2	TERMINAL STRIP, 5 TERMINALS EMC PART NO. 30438-5	5-140	71785	1
A228T1	TRANSFORMER,HIGH VOLTAGE	30155	25313	1
A228T2	TRANSFORMER EMC PART NO. 30156	TY468	81095	1
A228A1	400 HZ MULTIVIBRATOR	80480-1	25313	1
A228A1C1 AND C2	CAPACITOR,FIXED,ELECTROLYTIC, 4.7 UF,PORM 20 PCT,35V EMC PART NO. 30092-475	K4R7C35K	05397	1
A228A1C1	SAME AS A208C1			
A228A1C2 AND Q3	SAME AS A203C2			
A228A1C4	SAME AS A208C1			
A228A1R1	SAME AS A220R11			
A228A1R2	RESISTOR,FIXED,COMP., 270 OHMS,PORM 5 PCT, 1/4W EMC PART NO. 30009-271	CB2715	01121	1
A228A1R3 AND R4	SAME AS A221R51			
A228A1R5	RESISTOR,VARIABLE, 100 OHMS EMC PART NO. 30250-101	3067P-101	80294	1
A228A1R6	SAME AS A220R16			
A228A1R7	SAME AS A220R11			
A228A1R9	SAME AS A223R14			
A228A1R1	SAME AS A223R14			
A229	HEAT SINK ASSY	80274-1	25313	1
A229P1	CONNECTOR,PLUG, 9 PIN EMC PART NO. 30471-9	126-220	02660	1
A229Q1 AND Q2	TRANSISTOR EMC PART NO. 30550-2492	2N2492	16758	1
A229Q3 AND Q4	TRANSISTOR EMC PART NO. 30550-2015	2N2015	02735	1
A229Q5 AND Q6	SAME AS A229Q1			
A229Q7	TRANSISTOR EMC PART NO. 30550-2869	2N2869	02735	1
A229R1 AND R2	RESISTOR,FIXED,WIREWOUND, 0.1 OHM,PORM 5 PCT 3W EMC PART NO. 30015-1C8	SA31	14193	1
A229R3 AND R4	RESISTOR,FIXED,COMP., 2.7 OHMS,PORM 5 PCT, 1/2W EMC PART NO. 30001-27A	EB2R75	01121	1
A229R5	RESISTOR,FIXED,WORWOUND, 15 OHMS,10W EMC PART NO.30005-150	1712	44655	1
A230	TRANSISTOR AND DIODE BRACKET ASSY	80119-1	25313	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A230CR1 THRU CR4	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-3210	1N3210	16758	1
A230CR5 THRU CR12	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 1N1115	1N1115	01295	1
A230J1	CONNECTOR,JACK, 20 PIN EMC PART NO.30430-20	MRE20P	81312	1
A230J2	CONNECTOR,JACK,9 PIN EMC PART NO. 30458-9	MRA9P	81312	1
A230Q1 AND Q2	TRANSISTOR EMC PART NO. 30550-1483	2N1483	02735	1
A230Q3 THRU Q5	SAME AS A229Q7			
A230Q6	SAME AS A230Q1			
A231	TERMINAL BOARD ASSY	80077-1	25313	1
A231CR1 THRU CR4	SAME AS CR201			
A231C1	SAME AS A210C1			
A231C2 THRU C5	CAPACITOR,FIXED,ELECTROLYTIC, 75 UF,50V EMC PART NO. 30050-750M	NLW75-50	09023	1
A231R1 AND R2	SAME AS A210R4			
A232	TERMINAL BOARD ASSY	80163-1	25313	1
A232CR1	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-3048	1N3048	81483	1
A232CR2 AND CR3	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-752	1N752	81483	1
A232C1 THRU C4	CAPACITOR,FIXED,ELECTROLYTIC, 10 UF,50V EMC PART NO. 30050-100M	NLW10-50	09023	1
A232R1	SAME AS A205R6			
AR232R2	SAME AS R243			
A232R3 AND R4	RESISTOR,FIXED,COMP., 560 OHMS,PORM 5 PCT,1W EMC PART NO. 30002-561	GB5615	01121	1
A232R5	RESISTOR,FIXED,COMP., 1000 OHMS,PORM 5 PCT, 2W EMC PART NO. 30003-102	HB1025	01121	1
A232R6	SAME AS R202			
A233	TERMINAL BOARD ASSY	80076-1	25313	1
A233CR1 THRU CR4	SAME AS CR201			
A233CR5	SAME AS A208CR1			
A233CR6	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-965A	1N965A	81483	1
A233C1	SAME AS A210C5			
A233C2	SAME AS C201			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A233R1	SAME AS R208			
A233R2	RESISTOR,FIXED,FILM, 750 OHMS,PORM 1 PCT, 1/4W EMC PART NO. 30014-7500	RN65D7500F	79727	1
A233R3				
A235R3	SAME AS A202R5			
A233R4	SAME AS A212R3			
A233R5	SAME AS A207R11			
A233R6	SAME AS A201R3			
A234	+27 VOLT SUPPLY OVERLOAD PROTECTOR ASSY		25313	1
A234CR1	SAME AS CR201			
A234C1	CAPACITOR,FIXED,MYLAR, 1.5 UF,100V EMC PART NO. 30063-155	D1-155	99515	1
A234Q1	TRANSISTOR EMC PART NO. 30550-3053	2N3053	02735	1
A234Q2	SAME AS A230Q1			
A234Q3	TRANSISTOR EMC PART NO. 30550-3055	2N3055	02735	1
A234R1	SAME AS R213			
A235	OPERATIONAL AMPLIFIER BRACKET ASSY	80079-1	25313	1
A235CR1	SAME AS A208CR1			
A235R1 AND R2	SAME AS R208			
A235R3	SAME AS A202RK			
A235R4	RESISTOR,VARIABLE, 10K OHMS EMC PART NO. 30258-103	75R10K	73138	1
A235R5 AND R6	RESISTOR,VARIABLE, 100K OHMS EMC PART NO. 30258-104	75R100K	73138	1
A236	CONNECTOR BRACKET ASSY	80075-1	25313	1
A236CR1 AND CR2	SAME AS CR201			
A236CR3 AND CR4	SAME AS A201CR1			
A236CR5 THRU CR11	SAME AS CR201			
A236CR12	SAME AS A201CR1			
A236CR13	SAME AS CR201			
A236C1	SAME AS A223C8			
A236C2	SAME AS C201			
A236C3	SAME AS C227			
A236C4 THRU C6	SAME AS C202			

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A236C7	SAME AS C201			
A236C8	SAME AS C233			
A236C9	SAME AS A207C4			
A236C10	SAME AS C201			
A236C11	CAPACITOR,FIXED,PAPER, 3 UF,PORM 20 PCT,100V EMC PART NC, 30063-305	W1-305	99515	1
A236C12 AND C13	SAME AS C202			
A236C14	SAME AS A236C11			
A236C15	SAME AS C202			
A236C16	SAME AS C227			
A236C17	SAME AS A207C4			
A236R1 AND R2	SAME AS A220R6			
A236R3	SAME AS A201R15			
A236R4	RESISTOR,FIXED,COMP., 68K OHMS,PORM 5 PCT, 1/2W EMC PART NC. 30001-683	EB6835	01121	1
A236R5	SAME AS R243			
A236R6	SAME AS A207R6			
A236R7	SAME AS R208			
A236R8	SAME AS A207R6			
A236R9	RESISTOR,FIXED,COMP., 33 OHMS,PORM 5 PCT, 1/2W EMC PART NC. 30001-330	EB3305	01121	1
A236R10	SAME AS R208			
A236R11 AND R12	SAME AS A212R3			
A236R13	SAME AS R243			
A236R14	SAME AS R229			
A236R15 AND R16	SAME AS R208			
A236R17	SAME AS R204			
A236R18	SAME AS R229			
A236R19	SAME AS R208			
A236R20	SAME AS R204			
A236R21 THRU R23	SAME AS R208			
A236R24	SAME AS A220R6			
A238	CAPACITOR BRACKET ASSY	80078-1	25313	1

TABLE 6-3. PARTS LIST, MODEL EMA-910-11 DATA EVALUATION UNIT (Cont'd)

Ref Symbol	Description	Manufacturer's Part Number	Mfr's Code	Maint Qty
A238CR1	SEMICONDUCTOR DEVICE,DIODE EMC PART NO. 30600-4006	1N4006	04713	1
A238C1	CAPACITOR,FIXED,ELECTROLYTIC,DUAL, 20UF/20UF 250V EMC PART NO. 30066	AFH2-26	84171	1
A238C2 THRU C9	CAPACITOR,FIXED,ELECTROLYTIC, 500 UF,500V EMC PART NO. 30065-501M	AFH1-13-05	84171	1
A238R1 AND R2	SAME AS A210R17			
A238R3	RESISTOR,FIXED,COMP.,150K OHMS,PORM 5 PCT 1/2W EMC PART NO. 30001-154	EB1545	01121	1
A238R4 THRU R9	RESISTOR,FIXED,POWER, 2 OHMS,PORM 5 PCT,3W EMC PART NO. 30006-20A	3X2	63743	1
A238R10 THRU R13	SAME AS R240			